The Southern Surgeon

Subscription in the United States, $5.00

Vol. IX, No. 11

Copyright 1940 by
The Southern Surgeon Publishing Co.
November, 1940

THE TREATMENT OF MALIGNANT TUMORS OF THE SKIN

GEORGE T. PACK, M. D.
and
WILLIAM O. WUESTER, M. D.
New York

IN any discussion regarding the treatment of malignant tumors of the skin, it should be mentioned that perfect results may be obtained by any one of numerous methods. The flexibility in the choice of methods should prohibit the formation of any hard and fast rules concerning treatment. The best results from the curative, functional and cosmetic viewpoints are secured by the therapist who has at his command the equipment for all methods and a knowledge of the factors influencing the choice of treatment.

RADIATION THERAPY OF EPITHELIOMAS OF THE SKIN

Roentgen Therapy: High-voltage x-rays, with peak kilovoltage of 200 or more, are seldom used in the treatment of skin cancer, except for deeply-infiltrating lesions and as an adjunct for the treatment of metastatic carcinoma in which they have some value in exercising growth restraint.

Low-voltage x-rays of 50 to 140 kilovolts are most important in the treatment of cutaneous tumors. The target-skin distance varies between 0 and 30 cm., with or without filtration of 1 to 3 mm. of aluminum, depending upon the physical characteristics of the tumor. Higher voltage, greater target-skin distance and heavier filters are indicated whenever an increased depth dose is needed. Lower voltage, shorter target-skin distance, and less or no filter are indicated for superficial cancers.

The normal skin surrounding an epithelioma is shielded with lead during an x-ray treatment, allowing a border of normal skin

From the Memorial Hospital for Cancer and Allied Diseases, New York.

Read before the Postgraduate Surgical Assembly (the eleventh annual meeting) of The Southeastern Surgical Congress at Birmingham, March 11, 12 and 13, 1940.

around the epithelioma of 5 to 10 mm. For x-rays of 100 Kv., 1 mm. of lead will remove 99 plus per cent of the radiation. This thin lead is easily cut and molded to fit each individual lesion. The lead protective shield is held in place with adhesive plaster or by contact pressure from the various-sized cylinders attached to the open port of the x-ray machine for the purpose of limiting the field of irradiation. It is a well-known physical law that the smaller the field, the less the depth dose obtained, due largely to a decrease in the scattered tissue radiation. Consequently, for small areas, a larger total dose must be given to obtain the same therapeutic effect. MacComb has determined the erythema dose for varying skin portals when x-rays are generated at 100 Kv. and 5 ma., giving an intensity of 170 r per minute at 30 cm. target-skin distance. He found that skin portals with diameters of 0.5 cm., 1 cm. and 2 cm. required 350 r to give an erythema in 80 per cent of the cases. For portals of 3 cm. and 4.5 cm. in diameter, 280 r gave an erythema. He applied these fundamentals to the treatment of a series of 50 epitheliomas of the skin. Not one of the epitheliomas exhibited satisfactory regression when the dose was less than 12.5 T. E. D. (threshold erythema dose). From this data MacComb constructed a table in which the given doses were considered sufficient for epitheliomas of various diameters. As a general rule it is better to over-treat than under-treat. The dosage factor may be varied to suit an individual case. Epitheliomas up to 3 cm. in diameter may be treated by a massive single dose of 6,000 to 10,000 r, or may be treated by dividing the treatment, i. e., 3,000 r times 4 or 2,000 times 6. For the larger and ulcerating lesions, we prefer the latter schedule or weekly or bi-weekly treatments. When the treatment is divided over a period of time, the total dose administered is of necessity larger because of the interval of recuperation of the tissue.

Chaoul or Phillips Contact or Short-Distance Roentgen Therapy: This treatment is limited to a voltage range of 50 to 60 Kv. The thin copper filter (0.2 mm. cu., 0.2 mm. al.), or transmission anode, is so placed that the tube operates at contact or 3 to 5 cm. target-skin distance. Cylinders or cones of various sizes and shapes are used, depending upon the size of the epithelioma to be treated. These machines are ideal for the treatment of superficial cancers. Since a soft x-ray beam is utilized and these rays are largely absorbed in the superficial tissues, the deep structures are uninjured with large doses and the hazards of late radiation necrosis are lessened. The principles governing the use of the 100 Kv. machine are obtained here also (fig. 1).

Radium: The last few years have seen a marked change in the treatment of epitheliomas in regard to the use of radium. Whereas

formerly it was commonly used, now it is seldom employed. The dimensions of the common radium applicators and their approximate dosages are given in the accompanying table (table 1).

TABLE 1

Radium Applicators for Epitheliomas of the Skin

Type	*Size*	*Area-radiating Surface*	*Filter*	*Distance*	*Dosage Mg. Hrs.*
Square Plaque	1.8 cm. square..	2.0 sq. cm.	2 mm. Brass+0.2 mm. Platinum	1 cm.	800-1100
Long Plaque .	2.7 x 1.7 cm....	3.75 sq. cm.	"	1 cm.	1000-1400
Round Plaque	4.0 cm. diameter	7.0 sq. cm.	"	1 cm.	1400-1600
Tray	6.2 cm. diameter	17.5 sq. cm.	"	3 cm.	3000-3500

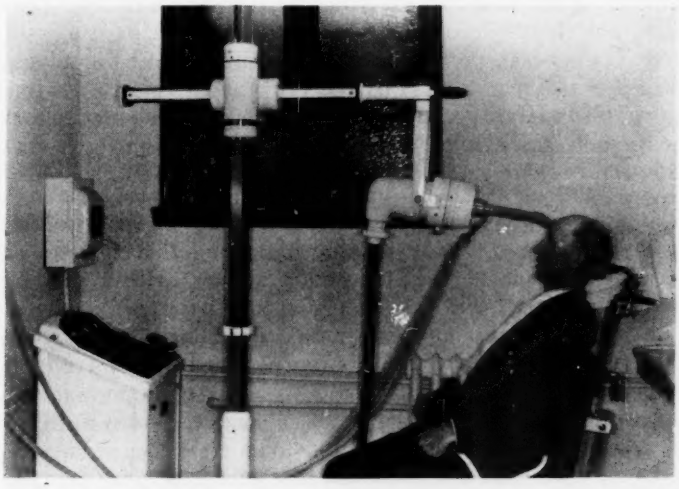

Fig. 1. Chaoul low voltage x-ray therapy of epithelioma of skin. Factors: 65 Kilovolts; 3 or 5 cm. target-skin distance; filter 0.2 mm. Cu.

The filtration of these plaques is the equivalent of 3 mm. of brass, which is the total filtration of the radium or radon capsule—usually 0.2 to 0.5 mm. platinum—plus the thickness of the brass case of the plaque. The plaques are applied at a distance of 1 cm. with the exception of the tray which is used at a target-skin distance of 3 cm. Balsa wood or bakelite is used to maintain this distance. It should always be remembered that 1 cm. of lead removes only 50 per cent of the radium energy, so that the problem of protecting the surrounding tissues is much more difficult than when using x-rays. This fact plus the comparative ease of the x-ray application and safety to the physician accounts for the growing preference for x-rays over radium.

Radium Moulage: This applicator is made of wax or dental modelling compound which can be molded to fit over very irregular surfaces where contact radium application is desired, i. e., in the region of the ear. The modelling compound holds the small radium tubes of 0.2 to 0.5 mm. platinum filter in direct contact with the uneven contour of the epithelioma. The dosage is computed on the basis of 75 to 100 mc. or mg. hrs. per sq. cm., the smaller dose being used when the cancer covers a larger area. A dose of 15 mc. hrs. per sq. cm. applied by contact with 0.5 mm. filtered radon tube is equal to one threshold erythema dose (T.E.D.). A surface dose of 6 T.E.D. is therefore given when a cancer is treated by contact radium therapy on a basis of 90 mc. hrs. per sq. cm. This technic can only be used for extremely superficial cancers and precancerous keratoses. It has many of the objectionable features described for radium, but there are occasional situations where its use is to be desired. In general, the dose per unit of surface to be irradiated is increased with the thickness of the filter and diminished with the extent of the surface irradiated. Such moulages are not necessary for extremely small epitheliomas, as a single radium tube may be held in contact with the cancer by a small strip of adhesive plaster.

Radon Seeds: Where a large amount of radium is available, it may be placed in solution (as chlorides) and the emanating gas collected by means of a Failla radon apparatus into small gold tubes having a wall thickness of 0.3 mm. These gold radon seeds for interstitial irradiation are 4 mm. long. They contain variable quantities of radon, usually 1 to 3 mc. per seed. They are inserted into the tumor under sterile precautions and remain permanently in the tumor long after the radon has been completely dissipated. The dose necessary for tumors of various diameters, depending on the number of threshold erythema units required, is given in table 2. When the radon seeds are scattered at equal distances throughout the tumor mass (as in a lymph node), instead of being placed in the center of the mass, the quantity of radon employed should be increased 25 per cent. Gold radon seeds are indicated in the treatment of small recurrent cancers, especially if located subcutaneously or whenever interstitial radon is desired as an adjunct to some other radium therapy. Care must be taken that radon seeds are not inserted too near cartilage, otherwise a painful and chronic perichondritis may follow.

Radon Bulb: Radon in the quantity of 300 to 600 millicuries is collected at intervals at the Memorial Hospital and deposited into a tiny glass sphere which is imbedded in a wax cup at the end of a long handle. This glass sphere is placed in direct contact with the lesions of the skin and doses varying from 200 to 600 "millicurie

TABLE 2

Quantities of Radiation Necessary To Deliver Specified Minimum Doses In Various Volumes Interstitial Sources, Filter 0.3-0.5 MM. Gold*

Threshold Doses	Volume—Cubic Centimeters						
	10	20	30	40	60	80	100
	Millicurie—or Milligram Hours						
1	275	380	470	530	650	750	845
2	550	760	940	1060	1300	1500	1690
3	825	1140	1410	1590	1950	2250	2535
4	1100	1520	1880	2120	2600	3000	3380
5	1375	1900	2350	2650	3250	3750	4225
7	1925	2660	3290	3710	4550	5250	5915
10	2750	3800	4700	5300	6500	7500	8450

*These doses are for use when the needles are to be left in place four days or longer. If they are to be removed in a shorter time, all quantities of radiation should be somewhat smaller. (Quimby, courtesy of the *American Journal of Roentgenology and Radium Therapy.*)

minutes" are used. As glass is the only filter, the radiation emitted is 97 per cent beta rays and 3 per cent gamma rays. The use of this applicator is therefore limited to precancerous lesions and keratoses and to very small and superficial basal cell epitheliomas.

Regardless of the histologic grading of any skin cancer, the dose selected is usually the one capable of sterilizing the most radioresistant epidermoid carcinoma with preservation of the normal tissues.

FACTORS INFLUENCING THE CHOICE OF TREATMENT

1. Location

The primary consideration in the treatment of epitheliomas is the destruction of the cancer and the preservation of the normal character of the surrounding tissues. Surgical excision of cancer of the eyelids, nose, ear, external auditory meatus, etc., may sacrifice organs and tissues difficult to replace by reconstruction. Judicious use of radiation therapy, provided the tissues are not condemned by cancers too deeply infiltrating, may avoid this mutilation.

Eyelids: Dangers to the eye from radiation are two: late cataract and iridocyclitis which may terminate in glaucoma. Of the three methods of irradiating cancer of the eyelids, namely, radon plaques, radon seeds and low-voltage x-rays, the last method is less dangerous to the eyeball. If low-voltage x-rays are directed through small cylinders to the epithelioma and the eyeball is protected by a small lead shield in the conjunctival sac, the lens receives practically

none of the dose delivered to the tumor. These eye shields may be inserted with the aid of topical anesthesia. This curved, oval lead shield is coated with a thin layer of wax. It serves two purposes: it removes a small amount of secondary radiation which may come from the lead, and it forms a less abrasive coating for the shield (fig. 2).

Fig. 2. A. Epithelioma of right lower eyelid. B. Following treatment by unfiltered low-voltage x-rays.

Nose: The majority of epitheliomas of the nose are of the basal cell type. Low-voltage x-ray therapy is preferred. The dose must be calculated carefully to prevent perichondritis and chondritis which may follow. Whenever the cartilage is invaded either by the primary or recurrent cancer, surgery or cautery excision is indicated. Rhinoplasty is done after a long interval, thereby allowing the region to be observed for recurrence. In lieu of plastic repair, especially in old patients, use may be made of a whole or partial artificial nose made up later and held in place by spectacles.

Ear and Ear Canal: Epitheliomas of the ear are treated by low-voltage radiation therapy unless the cartilage is destroyed. A radium moulage gives good results.

Hands and Feet: The skin over bony prominences is poorly nourished and is notorious for lack of recuperative powers following heavy irradiation. On account of this hazard, epitheliomas of the dorsum of the hands and feet are treated by irradiation only when superficial and not of great thickness. In old patients with atrophic

skin and in the case of infiltrating and movable cancers, wide surgical excision and immediate whole-thickness skin-grafting should be done. This skin-graft may be delayed if the cancer is so infected that it cannot be cleansed by hot antiseptic dressings. One must consider the type of tissue remaining after heavy irradiation. This skin will not tolerate injuries or weight-bearing well, therefore cancer of the sole of the foot, especially the heel, is usually treated by surgical excision and whole-thickness skin-grafting. If tendons or bone are involved, partial amputation of the hand, foot or toe may be necessary.

Scalp: Epitheliomas of the scalp may be either of the basal cell or squamous cell type. Some originate in sebaceous cysts. Although the scalp is highly vascular and should support irradiation well, late radionecrosis or later recurrence often follows radiation therapy. Wide surgical excision is preferred. If the epithelioma is at all invasive, wide excision by electrocautery down to the pericranium is the treatment of choice. Considerable time is required for this cancer to become fixed because the occipitofrontalis fascia offers a strong, almost avascular barrier to invasion. Involvement of the pericranium calls for sacrifice of this structure and perhaps of the outer plate of the calvarium. When the periosteum can be saved, immediate skin-grafting, using a split-thickness graft, may be done. Denudation of the bone after removal of the pericranium is relieved by drilling numerous holes in the outer plate with a dentist's burr. The diploic cavity sends granulations growing outward through these holes; spontaneous epithelialization or skin-grafting completes the healing.

Lip, Penis, Vulva: The treatment of epitheliomas in these locations is not within the scope of this paper.

2. Type and Stage of Cancer

Basal cell epitheliomas usually grow slowly and as a consequence are frequently detected early. The adenoid-cystic type of basal cell cancer exhibits increased radioresistance. Both types, however, are readily treated by roentgen rays. In a consideration of the radiosensitivity of epidermoid carcinomas, the factors of fixation and infiltration are more important than histologic grading. Little difference is seen in the response to radiation by epidermoid and basal cell cancers of the skin, if the size and depth of infiltration are equal, but the former is usually of more rapid growth with metastatic potentialities and therefore treatment is more urgent. Squamous carcinomas developing on the basis of burn scars, roentgen dermatitis, lupus, acrodermatitis and arsenical keratoses are much more radioresistant due to a pre-existing dermal fibrosis. Spindle

cell metaplasia of epidermoid carcinoma increases the radioresistance to a degree wherein the cancer will remain viable even though the normal surrounding tissues will slough from over-irradiation. Spindle cell cancers are therefore treated by surgical excision. Papillary carcinomas of considerable bulk are removed in part by surgical endothermy, leaving the base to be irradiated. If the epithelioma occupies a large surface area, fractionated x-ray therapy is preferred to a massive single dose. The superior results obtained con-

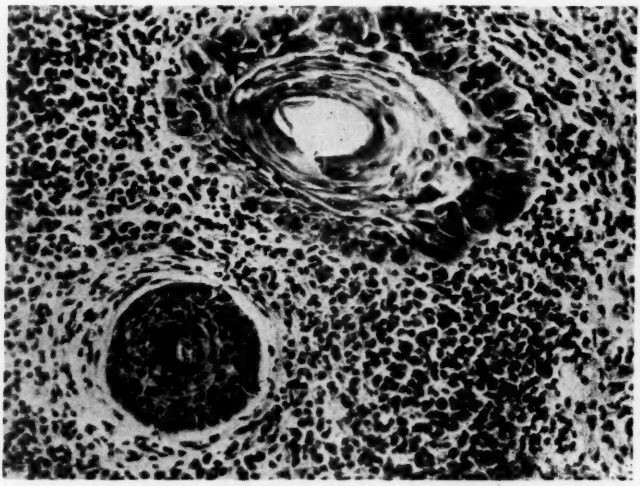

Fig. 3. Early hair matrix carcinoma.

tradict the opinion that metastasis is prone to occur during a prolonged treatment period. During the latter part of the divided-dose irradiation of large epitheliomas, one frequently observes a progressive epithelization of the treated area. Fixation usually contraindicates irradiation, e. g., in squamous cell carcinoma of the dorsum of the hand. Invasion of the bone requires surgical excision. The adenoid-cystic type of basal cell cancer seems to have a marked tendency to involve bone (fig. 3).

Surgical Treatment of Epitheliomas of the Skin

Many epitheliomas of the hands and feet, anterior tibial region, midline of the back, midsternal region and scalp, should be treated preferably by surgical excision. Into the same group fall epitheliomas which involve cartilage or bone, because heavy irradiation in this location may cause a perichondritis, periostitis or osteitis, which may slough and remain painful for many months. Other cancers

which are radioresistant due to the underlying condition of the skin, are those which develop in burn scars, lupus, radiation dermatitis, acrodermatitis and sebaceous cysts, and some cancers recurring after radiation therapy. The details of plastic reconstruction of such important anatomic parts as the ear, nose, etc., may be found in textbooks on reconstructive and plastic surgery.

Amputation may be necessary at times to control hemorrhage caused by erosion of a large vessel. Other indications for amputation are: 1, when the cancer has invaded so deeply and become so adherent that excision is impossible; 2, when the interior of a large articulation is extensively exposed; 3, when large areas of bone are exposed, resulting in necrosis; 4, when uncontrollable suppuration of the wound is complicated by fever and dangerous toxemia; and 5, when the functional result even after a presumptive local cure would be unsatisfactory, the limb becoming an encumbrance.

Treatment of Metastatic Carcinoma in Regional Lymph Nodes

Squamous carcinomas of the skin do not metastasize early to lymph nodes, therefore the problem of management of these nodes is not so important as in the case of epitheliomas of mucous membranes. Skin cancers developing in burn scars are extremely slow to metastasize because the lymphatics are obliterated. Ulcerating and infiltrating epitheliomas of the skin and any epidermoid carcinoma having metaplastic spindle cell characteristics, do metastasize to regional lymph nodes with some frequency. Metastases from squamous cell cancers may occur in the lungs, bones and abdominal viscera. Basal cell tumors of the skin do not metastasize to the regional lymph nodes.

Indications for Dissection of Regional Lymph Nodes: Dissection of these nodes is never done unless there is positive evidence of their involvement by metastatic carcinoma, which can be proven by aspiration biopsy. If the primary cancer is cured or is curable, the regional lymph nodes are examined at intervals during the years following. If routine dissection were done on these nodes, over 80 per cent of the operations would be found unnecessary. If the lesion is ulcerated and infected and the regional nodes are enlarged, it does not mean that they are involved with cancer. A negative report following aspiration biopsy of these nodes does not rule out the presence of metastases. The enlarged nodes may subside and become impalpable if the primary infection is controlled, but never if metastases are present. It is a safe rule to suspect all enlarged regional nodes of containing metastatic carcinoma until proved oth-

erwise. Whenever dissection of cervical, axillary or inguinal nodes is contemplated, it should be a radical procedure. The dissection of the nodes always follows the treatment of the primary cancer and is seldom done at the same time. The interval may vary between one and six weeks. The theoretical objection to the dissection of regional nodes and excision of the primary cancer at the same seance is based on several disastrous incidents in which this technic was followed by diffuse, brawny recurrence of the cancer in the axilla and groin. It was assumed that this unfortunate complication developed because embolic metastases occurred after the protective filter of the lymph nodes had been removed.

Radiation Therapy of Metastatic Cancer in Regional Lymph Nodes: Metastatic squamous cell or spindle cell carcinoma in nodes cannot be cured by external irradiation alone. The moist skin of the axilla and groin tolerates radiation poorly. Irradiation following radical dissection should be used as the method of choice. Such radiation therapy is given, not with the expectation of sterilizing residual cancer but of inducing fibrosis in these tissues, preventing the reformation of new lymphatic channels, and possibly exercising growth restraint on any viable cancer cells left after the dissection.

Individual cervical nodes containing metastatic carcinoma, if in an inoperable situation, may be handled by divided doses of roentgen therapy using the 200 Kv. machine and circular ports large enough to encompass the enlarged nodes only, followed by supplementary interstitial radiation therapy. The total x-ray dose may vary between 2,000 and 5,000 r units, depending upon the location of the region treated and the size of the portal. This treatment is more successful for cervical nodes because these nodes have strong capsules which restrain the carcinoma within the node. Axillary and inguinal nodes have delicate capsules, often infiltrated by fat, so that metastatic carcinoma may perforate early and invade the loose fat of the axilla and groin. Ten to twelve erythema units are necessary to sterilize these cancers. The depth dose required to total the ten or twelve erythema units based on the size of the nodes when directly measured is given by gold radon seeds with or without incisional exposure of the node.

Treatment of Recurrent Skin Cancer

As a general rule cancers of the skin recurrent after irradiation are best treated surgically because they have lost a considerable amount of their original radiosensitivity while at the same time the surrounding tissues are less tolerant to further radiation treatment. The location of the cancer, the amount of previous radiation and histologic type may influence this decision. For example, the spindle

cell metaplasia which may characterize cancer recurring in irradiated skin is a primary indication for surgical excision. Where the recurrence may occupy only a small part of the original tumor area, the use of gold radon seeds may be indicated or further external irradiation with the healed area protected by a lead shield. Cancers recurring after incomplete excision are difficult to cure by irradiation because the cells are growing in scar tissue and the location of the tumor may be very deep in or beneath the skin. In some instances an apparently benign lesion is excised and later reported as being cancerous. As only a suture line is visible, a decision must be made as to whether to perfect a more complete excision or whether to resort to roentgen therapy. If the latter method is chosen, it should be reinforced by the interstitial deposition of gold radon seeds.

Fig. 4. Bowen's disease. Multiple superficial epitheliomas of skin of trunk.

Selection of Treatment for Cancers of Certain Types and Origins

Bowen's Disease: This should be considered a true cancer and not a precancerous dermatosis. The treatment is identical with that for squamous cell carcinoma (figs. 4 and 5).

Paget's Disease: Although usually involving the nipple and areola and appearing as a skin lesion, it is invariably associated with cancer of the ductal system of the breast and it should be treated as breast cancer (amputation).

Cancer in Acrodermatitis Chronica Atrophicans: Squamous cell cancers occurring in this type of skin often have spindle cell characteristics and may metastasize by the blood stream. This type of

skin is entirely susceptible to radiation and either immediate or late ulceration. Wide surgical excision followed by skin-grafting is the proper treatment.

Cancer in Xeroderma Pigmentosa is a congenital familial disease occurring in the very young. It is characterized by a marked susceptibility of the exposed skin to radiant energy. Since actinic rays are undoubtedly factors in the development of these cancers, the disease, by its very nature, prohibits the use of roentgen rays and radium in its treatment. Because these multiple squamous cell cancers which inevitably develop, sooner or later cause death usually

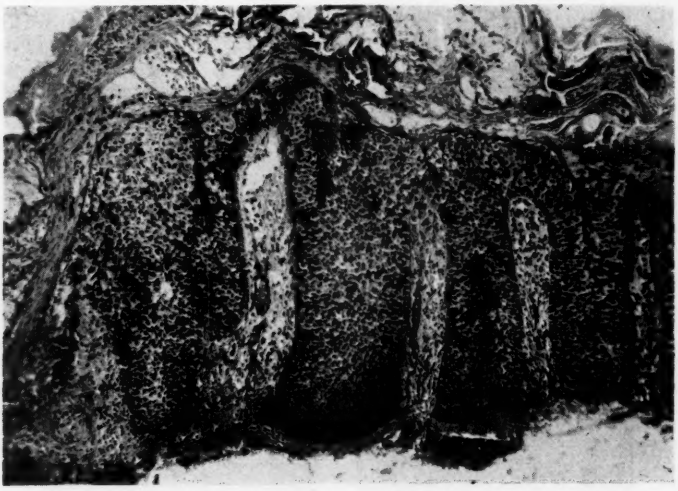

Fig. 5. Bowen's dyskeratosis, a form of skin cancer of low-grade malignancy.

at an early age, this precancerous disease presents a problem in management. Treatment is by excision by knife or endotherm, by coagulation or cautery. Dark clothing, large-brim hats protecting the face, gloves worn in daytime, indoor life and night employment for those who survive through childhood are recommended.

Cancer in Lupus Vulgaris and Lupus Erythematosis: These patients frequently relate a history of previous low-voltage roentgen therapy with epitheliomas developing later as secondary complications. They are essentially scar cancers. As such, wide surgical excision with plastic repair of the defect may be necessary. When this lesion occurs on the face, which is a common site, it is an individual problem whether immediate surgical excision and plastic repair is or is not preferable to irradiation and the danger of radia-

tion ulcer. Superficial cancers, even in this unfavorable tissue-bed, may be controlled by external radiation.

Arsenical Cancer: The hyperkeratoses occurring after prolonged administration of arsenic are situated in great abundance on the palms and soles. These keratoses may be treated by electrodesiccation, by the radon bulb or by unfiltered low-voltage x-rays. The epitheliomas which develop on these precancerous lesions may be either squamous cell or basal cell in type, slowly growing, somewhat radioresistant and metastasizing rather late to regional lymph nodes. They may be treated by low-voltage x-rays or by the application of radium plaques, observing the doses previously mentioned.

Fig. 6. A. Arsenical hyperkeratoses of soles of feet. An epithelioma has developed on the lateral aspect of the left foot overlying the left metacarpophalangeal joint. B. Result after treatment of hyperkeratotic skin with unfiltered low-voltage x-rays. The epithelioma was treated with radium plaque.

The danger of late painful radiation ulcers and radiation necrosis should not be overlooked in the treatment of lesions of the palms and feet. In view of this fact there is a growing tendency to perform wide surgical excision of cancers in these locations, followed by immediate whole-thickness skin-grafting (fig. 6).

Cancer in Chronic Radiation Dermatitis: This is chiefly an occupational disease of radiologists and technicians, although some cancers develop in the skin of patients who have been heavily irradiated some years previously. Further irradiation of cancers in this type of tissue bed is contraindicated. Surgical excision with skin-grafting is preferred. These cancers are usually squamous and occasionally exhibit spindle cell metaplasia. They metastasize relatively early to regional lymph nodes (figs. 7 and 8).

Cancer in Burn Scars: In a series of 40 burn-scar epitheliomas, not one patient had the burn originally skin-grafted. The average time consumed for complete healing was 800 days (more than two years). An average interval of 19 years elapsed between the occurrence of the burn and the development of the cancer. Hence, this type of skin cancer may develop in young adults who were burned in infancy. These cancers, sometimes referred to as Marjolin's ulcers, are slowly-growing, radioresistant neoplasms almost invariably of the squamous cell type. Wide surgical excision, followed by full-thickness skin-graft is the treatment of choice. The thin

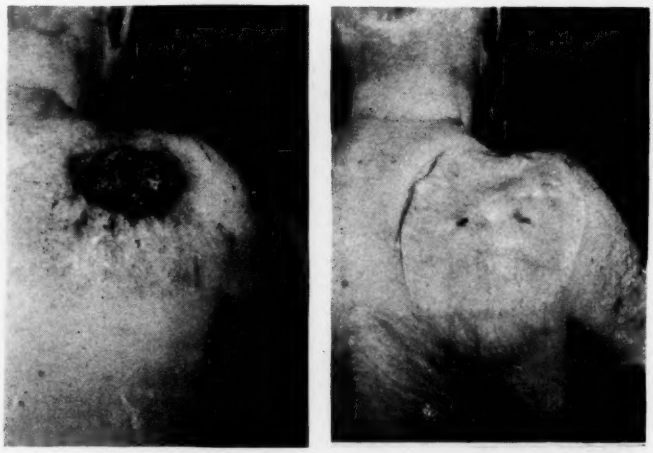

Fig. 7. A. Deeply infiltrating basal cell carcinoma of right scapular region. This tumor developed in skin damaged by intensive radiation therapy of a congenital nevus. Appearance on application to the clinic. B. Result after wide surgical excision, partial removal of scapular spine and application of Thiersch grafts.

Ollier-Thiersch skin-grafts are not used unless the extent of the wound following the excision precludes the employment of whole-thickness grafts, because the Thiersch grafts do not contain hair follicles, sweat glands and oil glands in abundance; in consequence of which the grafted area is dry and subject to the same degeneration as the scar tissue. All scar tissue is intolerant of irradiation. Radium and x-ray therapy are usually contraindicated for burn-scar cancers unless palliation only is desired for inoperable cancers.

Cancer in Draining Sinuses: Osteomyelitic, tuberculous or operative sinuses of long duration are sources of irritation which not infrequently develop cancers of the squamous type. The first problem is to eradicate the cause of the sinus if possible and this can seldom be accomplished by any other method than endotherm or wide surgical excision. In other instances, good results are obtained

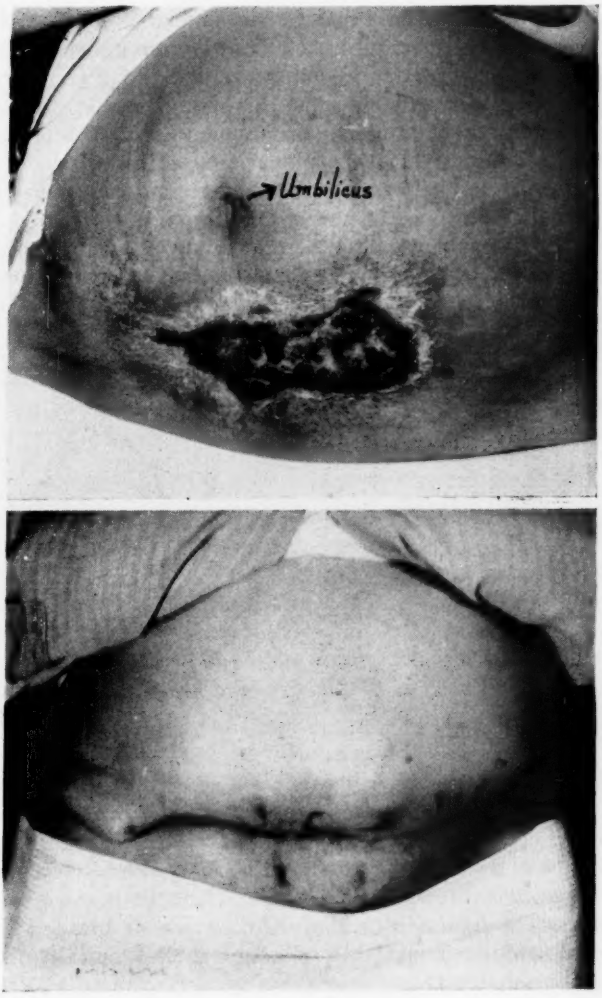

Fig. 8. A. Epidermoid carcinoma developing in scar of radium burn of abdomen. B. Result after radical surgical excision and plastic closure.

by the divided-dose technic rather than by massive x-ray therapy (fig. 9).

Treatment of Pigmented Nevi and Melanomas

The pigmented mole or neuronevus is of such universal occurrence that almost everyone is theoretically subject to the danger of melanoma, its malignant derivative. In an extensive analysis, it was found that the average person has eighteen pigmented moles.

Although pigmented nevi may be recognized shortly after birth, many do not make their appearance until after puberty. It is believed that the new nevi appearing after adult life, are merely the quiescent, previously-existing nevi becoming visible through increased growth. The malignant melanoma is seldom found in individuals before puberty. The explanation for this later occurrence is considered more likely to be related to certain endocrine stimulation. The sex hormones of the ovary, testis and pituitary, which become active at puberty, have a great influence on the pigmentary function. The marked growth and dissemination of melanomas in pregnant women lends further support to this hypothesis. Though

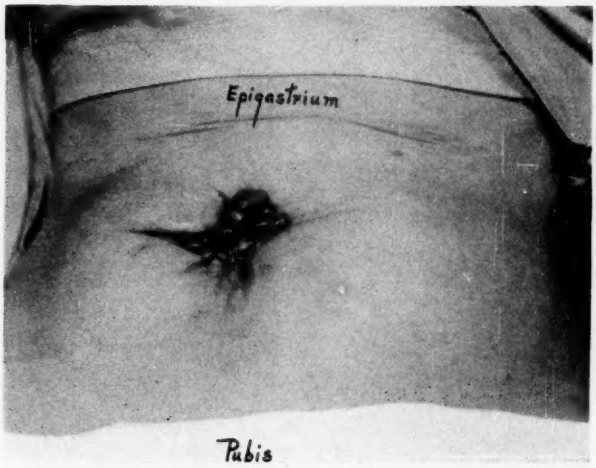

Fig. 9. Epidermoid carcinoma developing in discharging sinus. This sinus had persisted for 20 years following the removal of an intra-abdominal dermoid cyst.

melanomas are found in childhood, they are of low-grade malignancy and seldom metastasize, although microscopically they may be indistinguishable from melanomas occurring in an adult.

Chronic irritation by shoes, collars, corsets, suspenders, infections, or true trauma, etc., can convert a benign nevus into a malignant melanoma. Thirty to fifty per cent of patients with melanoma recite the history of an injury to a pre-existent nevus. Physicians should suspect all nevi which show an increase in size, a change in color, increase in pigmentation, ulceration, hemorrhage or infection.

Treatment of Nevi

Because of the age distribution factors, it is thought best to remove all darkly pigmented neuronevi in infancy and childhood.

They should be removed before adult life when they are more likely to undergo malignant degeneration.

The nevus is radioresistant and should never be treated by any form of x-ray or radium therapy. There is danger in removing these moles by electrodesiccation. Many true nevi are treated by dermatologists without mishap for every one that occurs as malignant melanoma, but the sequence of malignant transformation of an apparently quiet nevus following incomplete electrodesiccation has occurred with unpleasant frequency in the case histories at our disposal.

The proper treatment of the benign nevus is complete surgical excision, using either a scalpel or an endotherm cutting-current. A benign lesion so excised does not recur as melanoma. The common belief held by the laity, and by some physicians, that such removal of moles in a prophylactic sense may lead to subsequent development of melanomas is erroneous. The explanation lies in the fact that the patient was motivated to have the nevus removed because of some change which had developed within it, such as increased pigmentation, increase in size, elevation of the mole, hemorrhage, infection, irritation, pain or other slight changes which called his attention to this abnormality. These changes usually indicate that melanoma has already developed, and therefore the limited excision for the nevus is insufficient, with the result that the already-existing melanoma recurs in or adjacent to the wound.

Since the average individual possesses 18 to 20 pigmented nevi, it seems unwise to advise the removal of all such lesions. Those moles which are darkly pigmented, and which are on regions subject to irritation, and which show any evidences of irritation or increase in size, should be treated by surgical excision. Huge nevi, involving wide segments of skin, should be removed in infancy and childhood when the menace of malignant transformation is usually absent. If such a nevus is of too large an expanse to permit complete removal in one stage with skin-grafting, it may safely be done by serial operations. A large ellipse of the tumor is excised from the center, so that the scar of the approximated wound is a linear one through the center of the remaining portion of the nevus. The second stage removes another wide ellipse of tumor with the previous scar in the center of the excised tissue. It is safe to cut through pigmented nevi in children in performing multiple-stage operations, but this should never be done after the age of puberty, because of the great influence of such trauma in changing the character of the tumor. Sufficient time is allowed between the stages of these operations to permit stretching of the adjacent elastic skin, so that in the final stage only a single linear scar will remain.

Route of Metastasis of Melanoma

The majority of malignant melanomas metastasize by way of the lymphatics to the legional lymph nodes. The infrequent melanosarcoma which originates from the blue nevus of Jadassohn metastasizes by the blood stream. Occasionally the ordinary melanoma may be quite vascular or may rupture into venous tributaries and have a blood-borne type of dissemination. The location of a melanoma is more important in determining the route of dissemination than is the cell type. Frequently the primary neoplasm becomes surrounded by numerous secondary deposits in the deep or superficial lymphatic plexus. These daughter or satellite growths can be felt in the hypoderm through the skin before they are visible. Primary melanomas on the hands and feet ordinarily metastasize to the axillary or inguinal lymph nodes; the epitrochlear and popliteal lymph nodes are seldom involved, except when the primary tumor is deep enough to be in the path of drainage by the deep lymphatic vessels. Metastasis may be by embolism of tumor cells or lymphatic permeation. More than one lymph node is involved and the disease spreads to secondary groups of nodes and from thence quickly to the next chain. A melanoma which is only slightly pigmented or even non-pigmented may give rise to non-pigmented metastases. A careful observation of the manner of dissemination of a particular melanoma is of great importance in determining whether radical local excision and dissection of regional lymph nodes is to be done, or whether amputation is necessary, as it is in the case of lymphatic permeation from melanoma of an extremity.

Treatment of Malignant Melanoma

Radiation Therapy: In our opinion, irradiation either by x-rays or radium is not indicated in the treatment of melanomas. Less than 2.5 per cent of melanomas are radiosensitive. The melanomas which have been cured at the Memorial Hospital by radiation therapy have received doses sufficient to cause necrosis of the skin. Actual cautery would have secured the same result with more rapid healing, less pain and better cosmetic results. X-rays or radium therapy may be employed for a hopelessly inoperable melanoma in an attempt to exercise growth restraint, but even here the indications for its use are questionable.

Endotherm Excision: Wide endotherm excision of melanomas may be successfully employed in lieu of the sharp scalpel. The end-results in both should be approximately the same.

Surgical Excision: Once a diagnosis of melanoma is made, the choice of treatment lies between radical surgical excision by sharp

dissection or by endotherm excision. The ultimate goal is the wide removal of the tumor and repair of the surgical defect, but under no circumstances should the desire for primary closure of the wound influence the surgeon to limit the radical character of the operation. Because a very wide elliptical incision is made surrounding the tumor, it is seldom that such an excision can be followed by approximation of the resultant wound edges, and therefore, primary or delayed skin-grafting usually follows. The depth of the incision should always go to the underlying muscle bed. If the melanoma is on an extremity, the dissection is started from above downward in the opposite direction to the lymph flow. The skin containing the melanoma is handled with care in order not to squeeze the tumor. Venous oozing, unless profound, is largely ignored, in order to let the adjacent veins empty themselves into the wound rather than into the systemic circulation. If the melanoma is on the finger or toe, amputation is done rather than local excision, but in all other locations, except the eye, wide surgical removal with preservation of the part is employed, provided there are no secondary metastatic nodules in the immediate vicinity. If this occurs, amputation is advisable. Thiersch or ribbon grafts or whole-thickness grafts, if not too large, may be used to close the wound. Secondary grafts are usually of the pinch or Reverdin type.

Melanoma of the Face and Scalp: Because nevi are more frequent on the face and neck, the melanomas in these locations are detected relatively early because of their prominence. The mistake often made is unwarranted conservatism in removal because of possible mutilation. Wide surgical excision is the treatment of choice.

Melanoma of the Hands and Feet: Melanoma in general is more common on the foot than on the hand (2.5 versus 1 per cent). Curability of melanoma of the foot is only one-half as great as the curability of melanoma of the hand, a fact that has long been recognized. This is probably due to the fact that melanomas of the feet are subject to greater irritation from weight-bearing and pressure of the shoes. Extremely radical excision should be carried out, even though this may necessitate a partial amputation of the foot or hand in those instances in which simple excision and skin-grafting are not feasible.

Subungual melanomas, first recognized by Jonathan Hutchinson in 1886 and called "melanotic whitlow," are rare in comparison with other diseases of the nail. Fully developed, they are usually black, fungating, well-demarcated ulcers involving the nail sulci and matrix and elevating the nail. This melanoma sometimes has the appearance of purplish granulation tissue flecked with small areas of scattered black pigment. A point in diagnosis is a border

of coal-black color which is nearly always present at the edge of the involved nail. Early in its growth the tumor seems to be independent of the skin, growing from beneath, displacing and elevating the eponychium. A melanoma begins in the nail sulci more frequently than in the nail bed. Once the diagnosis of subungual melanoma is made, amputation of the digit should be considered an emergency, because the day or time of the metastases can never be foretold.

Melanoma of the Vulva: Two per cent of all melanomas are situated on the vulva. Pigmented moles are fairly frequent in this location. Trauma, chronic irritation, infection and constant moisture may stimulate the transformation of benign nevi into malignant melanomas. In some cases no precursory lesions have been apparent. Melanomas of the vulva are soft and delicate in structure, ulceration is frequent together with bleeding as these tumors are quite vascular. Because of their vascularity, blood-stream metastases are common. The majority of the labial lesions disseminate to the inguinal lymph nodes at an early date. The end-results for melanoma of the vulva are poor. Proper treatment consists of radical vulvectomy including bilateral groin dissection.

Melanoma of the Male Genitalia: Although rare, melanoma does occur in this location. The same radical procedure obtains as in melanoma of the vulva, namely, amputation and bilateral groin dissection.

Anorectal Melanoma: Two per cent of all melanomas in the human are located in the anus and rectum, and are usually situated in the anus or anorectal junction. If operable, the treatment is rectal resection, preferably an abdominoperineal extirpation with later bilateral groin dissection, even if the groins are not palpably involved. Lymphatics from the anus drain into the medial superficial inguinal lymph nodes, and on this account mere removal of the rectum is insufficient.

Treatment of Metastatic Melanoma in Regional Lymph Nodes

Several years ago a study of malignant melanoma of the extremities revealed that radical dissection of the primary melanoma often was not curative, even in patients in whom no regional lymph nodes were palpable. Many of these patients developed large nodes containing metastatic melanoma during their postoperative observation period. Since this study, all regional lymph nodes are dissected out as a routine procedure, even if the nodes are not palpable, about six to eight weeks after the primary excision. In over 50 per cent of the cases minute foci of metastatic melanoma (clinically unde-

tectable) were found. If melanoma is palpable in the nodes at the time of the primary excision, only a two week interval is observed. If melanoma cells are in transit in the lymphatics, they may be filtered out in the lymph nodes during this time. This procedure has prevented in many cases the development of new melanotic nodules in the intervening limb or diffuse recurrence in the axillary or inguinal wounds.

Routine dissection of regional nodes is not carried out in patients who have melanomas in the midline of the upper abdomen and midline of the back, since one is not able to tell in which group of nodes metastases may occur. Careful observation at frequent intervals is substituted for the so-called prophylactic dissection. Dissection of regional nodes is done in the radical manner in the groins, if there is gross evidence of metastatic involvement and the dissection is carried deeply into the pelvis. The deep iliac lymph nodes and the glands of Cloquet are removed after the inguinal ligament is severed to facilitate exposure. The dissection is carried out extraperitoneally.

Treatment of the Idiopathic Multiple Hemorrhagic Sarcoma of Kaposi

The choice of treatment depends upon the stage in which the disease is found. These stages are represented as follows: 1, the small, flat, brown or blue macule, 2, the later and larger nodular lesions composed mostly of proliferating connective tissue and small blood and lymphatic vessels (the granulomatous phase), and 3, the final or neoplastic phase represented by larger nodules and particularly the confluent, serpiginous lesions.

The lesions are most frequent on the lower extremities and are usually bilateral. One must realize that this is a systemic disease and treatment is limited to the external evidence. The course of Kaposi's sarcoma is slow, with an average duration of five to ten years before the patient dies of intercurrent disease, infection, hemorrhage, cachexia, or extensive visceral involvement, particularly of the gastrointestinal tract.

In the early stages the application of small radium plaques, or the use of shielded, unfiltered, low-voltage x-rays is preferred for the discrete tumors. For the larger, confluent and serpiginous lesions, unfiltered, low-voltage x-ray therapy, using fractionated treatments of sub-erythema doses, is indicated. Surgical excision is of little value except for the single tumor. Whenever radiation therapy is properly administered, it is gratifyingly successful.

BIBLIOGRAPHY

1. Affleck, D. H.: Melanomas, Am. J. Cancer *27:* 120-138, 1936.
2. Becker, S. W.: Melanotic Neoplasms of the Skin, Am. J. Cancer *22:* 17-40, 1934.
3. Butterworth, T., and Klauder, J. V.: Malignant Melanomas Arising in Moles, J. A. M. A. *102:* 739-745, 1934.
4. Dawson, J. W.: The Melanomata; Their Morphology and Histogenesis, a Study of Cell Origin and Transformations with a Critical Review, Edinburgh Med. J. n. s. *32:* 501-732, 1925.
5. Ellis, F.: The Radiosensitivity of Malignant Melanomata, Brit. J. Radiol. *12:* 327-352, 1939.
6. Evans, W. A., and Leucutia, T.: The Treatment of Melanotic Tumors of the Skin: Pigmented Moles and Malignant Melanomas, Am. J. Roentgenol. *26:* 236-259, 1931.
7. Ewing, J.: Neoplastic Diseases, ed. 3. Philadelphia: W. B. Saunders Company, 1928.
8. Joseph, J.: Nasenplastik und sonstige Gesichtsplastik nebt Mammaplastik. Leipzig: Curt Kabitzsch, 1931.
9. Lacassagne, A.: Indications respectives des differentes methodes de traitement des cancers cutanes. In: Traitement des Cancers de la Peau. Nouvelle Pratique Dermatologique. Vol. 6: 893. Paris: Masson, edit., 1936.
10. MacComb, W. S.: Low-Voltage Roentgen Therapy in Skin Cancer, Am. J. Roentgenol. *41:* 437-440, 1939.
11. Martin, H. E.: Radiation Therapy in Skin Cancer, Am. J. Cancer *19:* 605-621, 1933.
12. Masson, P.: Les Naevi Pigmentaires, Tumeurs Nerveuses. Ann. d'Anat. Path. *3:* 417-453; 657-696, 1926.
13. Meyer, H. W.: Neglected and Recurrent Basal-cell Epitheliomas of the Face, Surg., Gynec. & Obst. *64:* 675-683, 1937.
14. Montgomery, H., and Kahler, J. E.: The Blue Nevus (Jadassohn-Tieche): its Distinction from Ordinary Moles and Malignant Melanomas, Am. J. Cancer *36:* 527-539, 1939.
15. Pack, G. T.: Radiation Therapy of Cancers of the Orbito-Palpebral Region at the Radium Institute of the University of Paris, Arch. Ophth. *57:* 246-253, 1928.
16. Pack, G. T.: Radiation Therapy of Tumors of the Skin at the Radium Institute of the University of Paris, Arch. Dermat. & Syph. *18:* 286-289, 1928.
17. Pack, G. T.: Symposium: Tumors of the Hands and Feet: Introduction, Surgery *5:* 1-26, 1939.
18. Pack, G. T.: Tumors of the Hands and Feet. St. Louis: The C. V. Mosby Company, 1939, pp. 9-35.
19. Pack, G. T., and Adair, F. E.: Subungual Melanoma, Surgery *5:* 47-72, 1939.
20. Pack, G. T., and Anglem, T. J.: Tumors of the Soft Somatic Tissues in Infancy and Childhood, J. Pediatr. *15:* 372-400, 1939.
21. Pack, G. T., and Wuester, W. O.: The Development of Cancer in Acrodermatitis Chronica Atrophicans. (In press.)
22. Quimby, E. H.: The Grouping of Radium Tubes or Plaques to Produce the desired distribution of Radiation, Am. J. Roentgenol. *27:* 18-38, 1932.
23. Quimby, E. H.: Physical Factors in Interstitial Radium Therapy, Am. J. Roentgenol. *33:* 306-316, 1935.
24. Quimby, E. H., and Marinelli, L. D.: A Study of Cones or Other Collimating Devices Used in Roentgen Therapy, Radiology *26:* 16-26, 1936.
25. Scharnagel, I. M.: Treatment of Malignant Melanomas of the Skin and Vulva at the Radium-Hemmet, Stockholm. Acta Radiol. *14:* 473-490, 1933.
26. Snoke, P. O.: Anatomical Factors Influencing Malignancy of the Skin of the Face, Surg., Gynec. & Obst. *53:* 196-201, 1931.
27. Stewart, F. W.: Radiosensitivity of Tumors, Arch. Surg. *27:* 979-1064, 1933.
28. Treves, N., and Pack, G. T.: The Development of Cancer in Burn Scars, Surg., Gynec. & Obst. *51:* 749-782, 1930.
29. Watson, W. L., and Wuester, W. O.: General Considerations in the Radiation Treatment of Skin Cancers in the Region of the Eye, Am. J. Ophth. *21:* 261-263, 1938.
30. Wright, O. B.: Melanoma of the Labia, Western J. Surg., Obst. & Gynec. *39:* 91-101, 1931.

THE MILLER-ABBOTT TUBE FOR INTESTINAL FEEDING

LEO J. HAHN, M. D.
and
ARTHUR H. GLICK, M. D.
New York

THE tube developed by Miller and Abbott[1] has proven useful for decompressing the intestine in cases of intestinal obstruction,[2] and for locating the site of the obstruction by means of barium. It has also been used with satisfaction to obtain contents from various levels of the intestinal tract for study of the chemistry, physiology, and pathology of the tract, its contents and its motility.[3]

The purpose of this article is to call attention to a fourth use to which this tube has been put—namely its use as an instrument for direct intestinal feeding.

Jejunal feeding has been found to be of great value in a variety of cases in which it was necessary to maintain nutrition for varying periods, when oral or gastric feedings were impossible. Jejunostomy has been resorted to in the past with variable results. In some of these cases, jejunostomy is a life-saving procedure,[4] but any operative procedure is hazardous in a weakened patient, and jejunostomies sometimes leak and may be difficult to close. It would be advantageous to be able to obtain the benefits of a jejunostomy while avoiding the risk and difficulties of an operative procedure and its aftermath. Jejunal feeding through an intubated tube is a satisfactory substitute for jejunostomy.

Any tube which can be passed through the pylorus might serve this purpose if it could regularly be made to pass to and remain at the desired intestinal level. We believe the tube developed by Miller and Abbott fulfills these requirements better than any other tube so far devised.

Many tubes have been advocated for intestinal feeding beginning with the tube of Hemmeter in 1895. An excellent review of the history, development and varieties of these tubes has been published by Einhorn,[5] to which reference is made. More recently, Abbott[6] has devised a double feeding tube which keeps the stomach empty by suction applied to one lumen while feedings are passed through a second lumen. Abbott and Rawson[7] have offered a tube depending on valves to control the direction of flow. Stengel and Ravdin[8] have described the use of this tube immediately after gastric operations,

---

From the Surgical Service of Beth David Hospital, New York City; Dr. F. W. Bancroft, Director.

during which they pass the tube through the stoma of the anastomosis to the jejunum for prompt postoperative jejunal feeding.

All these tubes have proven useful, but none is completely satisfactory for all cases, mainly because it has been difficult to control the passage to and maintenance of the tube at the desired intestinal level. In this respect, the Miller-Abbott tube has a distinct advantage, as its descent along the intestine and maintenance at any desired level can usually be controlled by the inflation and deflation of the balloon which forms an integral part of the tube. Inflation causes peristalsis to carry the tube down—and it can ordinarily be held at any level by partial deflation plus anchorage at the nose. The tube itself has been described by Miller and Abbott,[1] and it is now so familiar to the profession, that the description will not be repeated here.

It is necessary for success in passing the tube to pay attention to details of technic which have been outlined by Miller and Abbott. Those hospital services have had a higher percentage of success in passing the tube in which one or more individuals have assumed the burden of familiarizing themselves with this technic.

It is not our intention to discuss the technic of passing the Miller-Abbott tube. These details are well described elsewhere. However, we wish to make a few suggestions about the management of this tube.

1. Continuous suction must be maintained until the tube passes the pylorus. For this purpose, we have relied on the Wangensteen suction bottles,[12,13] which have proven efficient.

2. The intubation of the pylorus was facilitated in many cases by having the patient lie on the left side.

3. It is advisable to wait twenty-four hours or longer if necessary, for the tube to pass the pylorus. X-ray check-up every six to eight hours is a useful guide. The balloon must not be inflated until the tube has passed the pylorus.

4. It is advisable to irrigate the suction (or feeding) portion of the tube at intervals in order to insure its patency.

We have used the Miller-Abbott tube for feeding purposes in three cases to date—each illustrating an entirely different condition:

1. For jejunal feeding (enabling us to avoid jejunostomy in a case of gastric and biliary fistula).

2. For intestinal feeding in a case of complete jejunal fistula.

3. For intestinal feeding in a case of persistent vomiting.

Report of Cases

Case 1. A woman, aged 38 years, was admitted to Beth David Hospital, July 7, 1939, complaining of intense jaundice. One year prior to her admission, she had been operated on at another hospital, and cholecystectomy per-

formed. Her common duct was accidentally injured, and an immediate repair performed, resulting in a stricture. After a preliminary drainage of her common duct to relieve her jaundice (Dr. Wade), she was operated on by Dr. Ziegler on Aug. 28, 1939, and the stump of the hepatic duct was implanted into the stomach over a T-tube. On the sixth day following this operation, she developed an external fistula through which all her stomach contents and bile leaked. Feeding by mouth was stopped and duodenal feedings were indicated. A Levin tube failed to pass the pylorus in twenty-four hours. For forty-eight hours a plain Rehfuss tube was tried without success. Before resorting to jejunostomy, it was decided to try a Miller-Abbott tube; this passed the pylorus over night on the thirteenth day following operation.

The Miller-Abbott tube was kept in place for three weeks, during which time the patient was fed through it. On the twenty-fifth day, the fistula had stopped leaking, and on the thirty-first day, the Miller-Abbot tube was removed after mouth feedings had been started and found not to cause leakage. The only complaint of the patient due to the tube was of pharyngeal irritation, during the last few days. This patient was fed albuminized orange juice, peptonized milk, lime water, sodium bicarbonate, meat juice, panopeptone, glucose, salt, and as much bile as could be collected from her drainage. She recovered completely.

We feel that this method of feeding obviated the necessity for a jejunostomy, and it is to be noted that the Miller-Abbott tube here was passed after the failure of the Levin and Rehfuss tubes to pass through the pylorus.

CASE 2. A woman, aged 49 years, was admitted to Beth David Hospital Nov. 17, 1939, with intestinal obstruction. On Sept. 11, 1939, she had been operated on for multilocular intraligamentous left ovarian cyst and supravaginal hysterectomy, bilateral salpingo-oophorectomy, and appendectomy performed. On the twelfth day, a complete dehiscence of her wound occurred with eventration of her intestine. The wound was resutured, and after a stormy convalescence, she was discharged on October 11.

On readmission November 12, she complained of cramps and vomiting of twenty-four hours duration. Operation under spinal anesthesia by one of us (L. J. H.) disclosed an adhesive peritonitis with a large quantity of bloody fluid in her abdomen. A high loop of jejunum, 8 to 10 inches long, was completely gangrenous, due to mesenteric thrombosis. As the patient was in very poor condition, the gangrenous loop of gut was exteriorized—clamps applied outside the abdomen, after the limbs of gut had been united for obstructive resection. As the patient's condition remained poor, the obstructed loops were opened in 24 hours, and to the surprise of everybody, the patient's condition then improved. After the loops could be identified, a catheter was passed down the distal loop for feeding, while a plain tube was passed up the proximal loop to collect as much bile and intestinal juices as possible. The catheter in the distal loop could not be advanced into the intestine far enough to prevent regurgitation of the feedings, so a Miller-Abbott tube was substituted and passed down until regurgitation ceased. The bile and secretions collected from the proximal loop were added to the feedings which consisted of peptonized milk, albuminized orange juice, cod liver oil, panopeptone, olive oil, salt, glucose, Valentine's meat extract, and vitamin preparations, as indicated elsewhere in this paper.

The patient improved for a while, but then lost ground. Digestion of the abdominal wall was difficult to control. The loss of much of her upper intestinal secretions caused her to go downhill rapidly. The Miller-Abbott tube was used November 23 to December 15. During this period, the spur had been cut down by clamps, and finally the fistula was closed, but the patient was too weak to survive.

In retrospect, we feel that if she had had the benefit of individual nursing care, this patient might have had a better chance. The feedings through the Miller-Abbott tube kept her going for a while, but were not sufficient to counteract the other adverse factors. An increased protein intake (with hydrolysate of peptone),[10] if it had been available, might have benefited this patient.

CASE 3. A woman of 40 a year prior to admission had been operated on for persistent vomiting due to pyloric stenosis. A Finney pyloroplasty had been performed, with relief of her vomiting. After eight months, the vomiting recurred, although Roentgen studies then showed a very wide pylorus. There was probably a large psychic factor in this recurrence of vomiting. Weight continued to decline, and it was thought that jejunal feeding was indicated to maintain nutrition. A Miller-Abbott tube was passed, and entered the duodenum over night. It was then passed down to the one foot mark and feedings instituted. Although the patient continued to vomit mouth feedings, the Miller-Abbot tube was kept in situ by partial inflation of the balloon, and jejunal feeding was successful in producing a marked improvement in her general condition.

The problem of a formula for jejunal feedings has attracted the attention of many investigators. The chief considerations are to provide:

1. Adequate caloric intake.
2. Sufficient fluid and electrolytes.
3. Sufficient protein.
4. Adequate vitamins of all classes.
5. Bile, if it is lost through a fistula.

Scott and Ivy[9] (1931) were able to keep dogs alive for several months by exclusive jejunal feeding with their pabulum. This formula, while physiologically adequate, was devised for feeding through a relatively wide jejunostomy tube and is rather too thick to flow freely through the small tube and fine perforations of the Miller-Abbott tube. In our cases, the principal difficulty with the formula was to get in sufficient protein without thickening the mixture so that it would not flow freely through the fine lumen and perforations of the tube. For this reason, we have avoided eggs, flour and gelatine, and have relied on milk, panopeptone, and albumin added to fruit juices to get enough protein. This problem has now been solved by Ravdin, Stengel and Prushankin,[10] who have pointed out that peptone hydrolysate of beef origin will soon be available.

Predigestion or partial digestion of some of the ingredients is advisable. The fluid must be non-irritating to the intestine to avoid diarrhea.

The feeding formula must vary with the individual requirements of the case, and checks of the serum protein and blood chlorides should be made. In general, we offer the following suggestions for a twenty-four hour feeding.

	Grams			Calories
	P	C	F	
1500 c.c. peptonized milk	52	75	60	1048
500 c.c. 20% cream	14	14	100	1012
500 c.c. albuminized[1] orange juice	8	50	..	232
60 c.c. panopeptone[2]	4	11	..	60
30 c.c. olive oil[3]	..	..	30	270
10 c.c. cod liver oil	..	..	10	90
30 c.c. Valentine's meat extract[4] (mainly for the ash)	1.3	..	..	22
10 c.c. table salt				
oxgall or bile from biliary fistula if needed				
30 c.c. Vitamin B complex (Lederle) fluid				
1000 c.c. 10% glucose sol.	..	100	..	400
3670	79.3	250	200	3134

[1]Whites of three eggs to the quart.

[2]Aminoids (Arlington) can be substituted for panopeptone, and contains 44.5% amino acids, dipeptides and prior nitrogenous molecules, with 6.3% inorganic salts and vitamins B, C, and D, according to the supplier.

[3]This amount of fat may cause diarrhea and may have to be reduced.

[4]Valentine's meat extract contains besides other substances: calcium, magnesium, potassium, sodium, iron, chlorides and phosphates.

Although not available for our reported cases, we would in future when obtainable incorporate in our formula hydrolysate of peptone as advocated by Ravdin, Stengel and Prushankin.[10]

All foods must be strained, and especial care given to straining the orange juice.

We have arranged the feeding apparatus very simply: an ordinary calibrated glass cylinder serves as a reservoir; it is connected to the Miller-Abbott tube by rubber tubing; the rate of flow of a simple gravity drip is controlled by use of a screw clamp. We have not found it necessary to make use of the more elaborate pump system described by Stengel and Vars.[11]

The feeding can proceed over the twenty-four hour period during sleep as well as waking hours at the rate of approximately 200 c.c. per hour. This is accomplished by drip of 5 c.c. per minute for forty minutes and twenty minutes rest—but the rate must be slowed up if the patient complains of distention or distress.

All the various ingredients should not be mixed together, because coagulation of the milk will occur if mixed with the orange juice, so the feeding has been divided into three parts which are given in rotation, with tap water being given between the successive parts in order to prevent mixing within the tube. Otherwise, coagulation and clogging of the tube or perforations will occur. The milk and cream are given in one section, the orange juice and oils in a second section, and the other components in a third section. In this way clogging of the tube is prevented.

The mixtures are kept on ice until needed, and warmed to remove the chill before using. Hot water bags surround the cylinder reservoir, but care must be taken not to heat the milk mixture enough to cause coagulation.

We have kept the tubes in place for three week periods in two of our cases without producing any ill effects from the prolonged presence of the tube. However, we are informed by personal communications that ulceration of the pharynx followed by mediastinitis has occurred from prolonged retention of a gastric tube; and pyloric ulceration with hemorrhage has resulted from the irritation of a duodenal tube.

Summary

Three cases illustrate three different conditions in which feeding by the Miller-Abbott tube was employed with satisfaction. Undoubtedly, the method will be found advantageous in many other types of cases. We would like to mention a few observations which we have made in our experience with these three cases, and in other cases in which the Miller-Abbott tube has been used for other purposes.

1. The successful intubation of the intestine with the Miller-Abbott tube can usually be accomplished if careful attention is given to details of technic. On the other hand, failure will often result if the work is delegated to untrained personnel.

2. The Miller-Abbott tube will sometimes pass the pylorus when other tubes fail to pass (case 1). It can be passed far enough into intestinal fistulas to accomplish feeding without regurgitation (case 2). It will remain in position in the jejunum even when food ingested into the stomach is being simultaneously vomited (case 3).

3. Jejunal or ileal feeding can be accomplished by this tube in a variety of cases.

4. The feeding formula should be varied according to the requirements of the case. Blood chemistry should be frequently tested as a guide—particularly the serum protein and blood chlorides.

5. Distention and other abdominal symptoms can be avoided by controlling the rate of feeding and by applying suction to the tube if necessary. A gravity drip method is efficient.

6. Diarrhea can be controlled by reducing the fat intake.

7. Nutrition can be maintained by this method (and jejunostomy avoided) in cases where oral and gastric feedings are contraindicated or impossible.

8. For feeding purposes the perforations in the tube may be enlarged so that they will not become easily clogged with coagulated food particles.

9. Special nursing is important as constant attention to detail is necessary for success. Accurate records must be kept of fluid intake and output, and caloric and protein intake.

10. The tube can be left in situ for periods of three weeks or more without harmful effects. Careful mouth hygiene is advocated. Chewing gum is useful. Spraying of the pharynx with an oily spray is recommended to allay pharyngeal irritation due to the long continued retention of the tube.

BIBLIOGRAPHY

1. Miller, T. G., and Abbott, W. O.: Intestinal Intubation: A Practical Technique, Am. J. M. Sc. *187:* 595-599 (May) 1934.
2. Abbott, W. O., and Johnston, C. G.: A Nonsurgical Method of Treating, Localizing and Diagnosing the Nature of Obstructing Lesions, Surg., Gynec. & Obst. *66:* 691-697 (April) 1938.
3. Abbott, W. O., and Miller, T. G.: Technic for the Collection of Pure Intestinal Secretion and for Study of Intestinal Absorption, J. A. M. A. *106:* 16-18 (Jan. 4) 1936.
4. Oppenheimer, G., and Druckerman, L. J.: Jejunostomy for Alimentation; Life-Saving Procedure, J. Mt. Sinai Hosp. *5:* 610-615 (Jan.-Feb.) 1939.
5. Einhorn, M.: New Bucketless Lead Weighted Gastroduodenal Tube with Review of American Contribution to Development of these Tubes, Am. J. Digest. Dis. *5:* 77-80 (Apr.) 1938.
6. Abbott, W. O.: As reported by Stengel and Ravdin. (Reference 8.)
7. Abbott, W. O., and Rawson, A. J.: Tube for Use in Post-operative Care of Gastro-enterostomy Cases, J. A. M. A. *108:* 1873-1874 (May 29) 1937.
8. Stengel, A., Jr., and Ravdin, I. S.: The Maintenance of Nutrition in Surgical Patients with a Description of the Orojejunal Method of Feeding, Surgery *6:* 511 (Oct.) 1939.
9. Scott, H. G., and Ivy., A. C.: Jejunal Alimentation; Experimental Study in Dogs, Ann. Surg. *93:* 1197-1201 (June) 1931.
10. Ravdin, I. S.; Stengel, A., Jr., and Prushankin, M.: The Control of Hypoproteinemia in Surgical Patients, J. A. M. A. *114:* 107 (Jan. 13) 1940.
11. Stengel, A., Jr., and Vars, H. M.: An Apparatus for Continuous Intravenous Injections in Unanesthetized Animals, J. Lab. & Clin. Med. *24:* 525 (Feb.) 1939.
12. Wangensteen, O. H., and Paine, J. R.: Treatment of Acute Intestinal Obstruction by Suction with the Duodenal Tube, J. A. M. A. *101:* 1532-1539 (Nov. 11) 1933.
13. Wangensteen, O. H.: The Therapeutic Problem in Bowel Obstructions. Springfield, Ill., Charles C Thomas, Publisher, 1937.

PRIMARY PNEUMOCOCCUS PERITONITIS IN AN ADULT

With Recovery Following Specific Serum Treatment

W. DUNCAN OWENS, M. D.
Miami Beach

PRIMARY pneumococcus peritonitis was known for many years before the bacteriologic era and was described in the literature under such names as idiopathic peritonitis in children, essential peritonitis of young girls, and cryptogenic peritonitis. The pneumococcus was recognized as its exciting cause as early as 1885, which was only four years after the isolation and naming of this organism.[1]

In spite of its very respectable age the disease is still only imperfectly understood. Its frequency, the route of the pneumococcus to the peritoneum, its diagnosis, and the principles which should determine its treatment are yet open to discussion. The reasons why it shows so marked preference for the ages between 2 and 10 years and for the female sex have not yet been made clear. Lastly, there is the continued high death rate to demand our further study.

These reasons influence me to report the only proven case of general peritonitis due to the pneumococcus occurring in the approximately 150,000 admissions to the Jackson Memorial Hospital, Miami, and to the St. Francis Hospital, Miami Beach. Further reasons for reporting this case are that it seems undoubtedly to have been of primary origin, the patient was 68 years old, and recovery occurred following operation without drainage and the use of type-specific anti-pneumococcic serum.

INCIDENCE

While this disease cannot properly be called rare, it is infrequent. In the Hospital for Sick Children, London, Thomas[2] found only 9 cases in 10 years but he states that in Edinburgh the pneumococcus is one of the most common causes of peritonitis. In a Paris hospital Mathieu and Davioud[3] saw 12 cases in 2 years. In Italy Silvestrini[4] saw 8 cases in 1 year. In the Wurzburg University Clinic, Hetterich[5] found only 2 cases in adults over an 8 year period. From Australia, Williams[6] reports 45 cases (31 primary, 14 secondary) treated at the Children's Hospital, Melbourne, in a 10 year period. Pneumococcus peritonitis is termed primary when there is no demonstrable lesion elsewhere in the body from which the infection of the peritoneum could have been derived; secondary when such lesion can be demonstrated. The primary type has been reported more

frequently than the secondary, perhaps because the secondary form, occurring as a complication, is either not recognized or is thought of merely as a complication.

In some of the European reports the frequency of the disease is recorded in terms of comparison with the incidence of acute appendicitis. Drachter[7] reports 1 case of pneumococcus peritonitis to every 29 of appendicitis at the Munich University Clinic and quotes Salzer's finding of 9 to 55; Schaanning[8] gives figures for 2 hospitals in Norway: in one there was an incidence of 1 to 15 and in the other of 1 to 7. These figures are for hospitals for children only. Schaanning further states that Obadalek, from a children's clinic in Bruenn, Czechoslovakia, saw 1 case of pneumococcus peritonitis to every 40 cases of appendicitis. It appears that the incidence of pneumococcus peritonitis in Europe, or, at least, the reported incidence, varies rather widely and without evident cause, from one clinic to another.

In this country Newell[9] reports 36 cases of primary pneumococcus peritonitis in 25 years at the Harriet Lane Dispensary of Johns Hopkins Hospital. In two other Baltimore hospitals Horine[10] saw 2 cases in 1½ years. Cole[11] reported 26 cases (only 9 of which were primary) in 18 years at Barnes Hospital, St. Louis. At Mount Sinai Hospital, New York, with 100 beds for children, Bass[12] found 19 cases in 12 years. He stated that Duncan has reported 34 cases in a 10 year period in Toronto. At Lenox Hill Hospital, New York, Fricke[13] found 10 cases in 5 years. It is evident that few clinicians, even those practicing in medical centers, have an opportunity to study more than a few cases of the disease, scattered over the years.

Sex and Age

About 75 per cent of all cases of primary pneumococcus peritonitis are said to occur in little girls between the ages of 2 and 10 years. Secondary pneumococcus peritonitis shows no sex preference. Cases that were primary so far as could be ascertained have occurred in boys and in adult men and women. In cases occurring in the first year of life, the male sex seems to be well represented. In adult life the preference for the female sex appears to hold.

Lipshutz and Lowenburg[14] think that peritonitis in infancy is probably not as infrequent as generally believed, that owing to the great absorptive ability of the peritoneum in infancy many cases go on to recovery without diagnosis. They state that encapsulation of a peritoneal infection is not a usual reaction in the infant, that in the very young the defensive reaction of the peritoneum is characterized by extraordinary rapidity of absorption. Lipshutz and Lowenburg[14] and Newell[9] have reported series of cases of pneumo-

coccus and of streptococcus peritonitis in infancy and childhood. In these two series there are approximately 5 cases of primary streptococcus peritonitis to 7 of primary pneumococcus peritonitis. In Newell's series of 61 cases, peritonitis due to the pneumococcus occurred between 1 and 10 years of age and that due to the streptococcus between 6 months and 2 years. Pneumococcus peritonitis in early infancy is, however, not unknown. Montgomery[15] observed a case in an 8 weeks old male infant and cited the cases of Dudgeon and Sargent in a 7 weeks old boy and of Klaus in a 9 weeks old infant. Hymanson[16] saw a case in a 9 weeks old male infant, associated with pneumonia; it is difficult to judge from the report which disease was primary. Williams'[6] series contained 2 cases in male infants, in which the peritonitis was associated with umbilical cord sepsis.

The literature contains a sprinkling of cases of primary pneumococcus peritonitis scattered through the years of adolescence and of early and middle adult life. So far as I have been able to discover, no case has been published which occurred later in life than the case I am reporting. Sostegni[17] has reported a case in a woman of the same age. Funck-Brentano[1] mentions a case said to have been reported by Achard, in which the patient was a 72 year old woman, but in the reference given by Funck-Brentano I was unable to discover any mention of such a case or of Achard, and further search proved fruitless.

Mortality

The mortality of pneumococcus peritonitis is variously given at from 50 to 90 per cent. The secondary form is said to be even more fatal than the primary form. Some authors have attempted to distinguish between a diffuse and a localizing form and state that the latter has a lower mortality than the former. But this might be another way of saying that the period of greatest danger is the first few days, before the localizing process has had time to start, and that if this period is survived the patient's prospects are more hopeful.

Modes of Infection

Of the four possible routes by which the infection might reach the peritoneum, the blood stream and the vaginal route (for the female) have, perhaps, the strongest backing, but the lymph stream and the intestinal route do not lack advocates. In about one half the cases, the pneumococcus of the same type that is infecting the peritoneum, can be cultured from the circulating blood, but it is more often absent in the earliest stage of the illness, which suggests that its presence in the blood may be a consequence rather than a cause of the peritoneal infection. Another objection that is raised

against a hematogenous origin is the rarity of peritonitis as a sequel of pneumonia, compared with the frequency with which pneumococci are found in the circulating blood in the latter disease. Elkin[18] found only three cases of pneumococcus peritonitis in nearly two thousand cases of pneumonia. A preceding tonsillitis is apparently more frequent than a preceding pneumonia and a prodromal stage with mild upper respiratory symptoms is not rare. Very rarely, pneumonia has been reported as present in another member of the household at the time that pneumococcus peritonitis developed,[19,20,21,22] and in some of these cases it was demonstrated that the same type of pneumococcus (type 1) was present in the thorax of the one patient and in the abdomen of the other.

The belief that pneumococci causing peritonitis enter the body by way of the vagina and reach the peritoneal cavity via the Fallopian tubes or the parametrial tissues is based mainly on the greater frequency of pneumococcus peritonitis in females than in males, which is so striking that at one time the disease was held to be confined to females. This theory of origin offers explanation for the age limits—2 to 10 years—between which some 75 per cent of cases are said to occur. According to Ryan[23] the epithelial separation of the walls of the vagina is not fully established until after the third year and, according to Thomas,[2] the vagina of the infant is occupied by a plug of mucus. Either of these factors would facilitate infection. After the age of 10 years vaginal secretion is normally sufficiently acid to militate against both infection and growth of the organisms.

The pneumococcus can sometimes be demonstrated in smears from the vagina of patients with pneumococcus peritonitis[48] while in other cases it cannot be so demonstrated; at times the organism can be demonstrated in vaginal smears from healthy women. Williams[6] has observed a connection between gonococcus vaginitis and the presence of pneumococci in the vagina of little girls. It is a common observation that pneumococcus peritonitis is most frequent in children living in unsanitary surroundings and not brought up in a way of personal cleanliness. While these observations would seem to favor the theory of ascending infection, we have to consider Obadalek's[24] statement that genital infection rarely ascends prior to puberty.

Among reported cases of pneumococcus peritonitis in adult women are several which developed during pregnancy and the puerperium. Marnierre[25] reported 3 such cases occurring late in the puerperium. Nuckols and Hertig[49] in 1938 collected 77 cases of pneumococcus infection in the genital tract in women and found that all but 23 were associated with a recent obstetric episode. In

1940 Bennett and Mengert[50] added 2 cases. Nuckols and Hertig[49] assume a positive position against an ascending infection while Tompkins[51] thinks it fair to assume that the infection is ascending unless there is a clear history to the contrary. I[48] have seen one case of pelvic peritonitis due to the pneumococcus, in an adult, which was certainly of the ascending type. McCord[26] has reported 2 cases, one of which developed 12 hours and the other 3 days after normal, easy delivery; no vaginal examinations had been made during labor. He states that during a period of 1 month he saw several other patients who died with the same general symptoms but from whom no positive blood cultures were obtained and in none had vaginal examinations been made. Since his observations were made in the obstetric wards of the same hospital it is possible that he was dealing with a small epidemic of pneumococcus peritonitis in puerperae.

Origin of pneumococcus peritonitis from the intestinal tract supposes migration of the organisms through the intact intestinal wall. Advocates of this theory suggest that the pneumococci could have been taken in with food or swallowed in the saliva and point to the diarrhea, which is so impressive a feature of this type of peritonitis, as indicative of an intraintestinal infection. Obadalek[24,27] is said to have succeeded in producing pneumococcus peritonitis in animals by the feeding of pneumococci.

The lymphatic route of spread to the peritoneum is difficult of support particularly because the flow of lymph through the diaphragm is from the abdomen toward the thorax and not vice versa. The lymph from the neck enters the blood stream at a level higher than the diaphragm. Furthermore, Lipshutz and Lowenburg[14] believe that the ravages of the disease are too widespread and too intense for a lymphatic origin and would bespeak a massive lymphatic infection which has no parallel in pathology.

The theoretical difficulties in the way of primary infection of the peritoneum are in keeping with the known infrequency of such infection. It would seem most probable that infection succeeds in getting through to the peritoneum by surmounting sometimes the obstacles that guard one route and sometimes those that guard another, according to the circumstances in the individual case.

Pathology

In the first stage, though there is no true pus, there is present throughout the peritoneal cavity a thin, serous, turbid, odorless fluid, creamy or grayish-yellow in color. The peritoneum has a slippery, slimy feel and there may be flakes of fibrin deposited over the serosa but marked reddening is not always present. In the in-

termediate stage true pus is found diffusely. In the third stage a thick fibrinous exudate is found, together with the formation of adhesions and abscesses. These abscesses, usually in the lower abdomen, may rupture spontaneously into the rectum or through the umbilicus. The third stage does not appear until about or after the fourth day. In cases of general pneumococcus infection coexistent pneumonia, pleurisy or pericarditis are common but in the uncomplicated case the changes are limited almost entirely to the abdomen.

Symptoms and Diagnosis

The four cardinal symptoms are abdominal pain, fever, vomiting and diarrhea. These all appear early. The typical onset is sudden, often fulminant, but it has frequently been noted that the patient may not look as ill as the severity of the symptoms would warrant. The Hippocratic facies is absent or appears only in the terminal stage.

The pain is diffuse but may be more intense over the lower abdomen and at first may appear to be localized in the right lower quadrant. Abdominal pain is usually the earliest symptom and comes on suddenly, without warning.

The chief characteristic of the fever of onset is its rapid rise. Commenting on a temperature of 103 F. attained within the first eighteen hours of illness in a case of pneumococcus peritonitis observed by him, Ryan[23] remarked that under no circumstances does acute appendicitis produce a temperature of this height within the first twenty-four hours. If the patient survives the first four or five days, the temperature usually falls. It may decline to normal and no further febrile episode ensue. More often the temperature rises again after a period of days or weeks in which it has ranged around the subfebrile. The febrile stage that now sets in is that of swinging temperature which is characteristic of pus formation. Perhaps to be termed atypical, but not unusual, are cases in which the initial fall in temperature does not take place and a high temperature is maintained until replaced by the stage of intermittent fever. Cases of this sort are often diagnosed as typhoid fever. Cases that are first seen in the stage of oscillating temperature with the distention of the abdomen, evidence of free fluid or an encysted abscess palpable through the abdominal wall that go with this stage are likely to be mistaken for tuberculous peritonitis.

Vomiting is a nearly constant symptom. In some cases it stops after the period of onset, in others it remains as a prominent feature of the clinical picture. It is sometimes projectile in character. There may be great difficulty in retaining even the smallest quantity of water.

From the standpoint of the diagnosis, diarrhea is an important symptom. The diarrhea in pneumococcus peritonitis is described by Suiffet and Campo[28] as a *true* diarrhea, fetid, serous, abundant, with colicky pain. Mathieu and Davioud[3] consider that the character of the diarrhea is the basis for the diagnosis, diarrhea in appendicitis, when present, never having the same acute enterocolic character. Diarrhea is said by Horine[10] to be less constant in secondary pneumococcus peritonitis than in primary. It was reported as absent in all of Johnston's[29] five cases, three of which were primary. Pederzoli[30] reports constipation instead of diarrhea in his child patients. It is evident that absence of diarrhea is not conclusive as against a diagnosis of pneumococcus peritonitis, but its presence in a case of peritonitis points suggestively to the pneumococcus.

Tenderness and rigidity are diffuse rather than localized. In other respects the results of physical examination of the abdomen vary considerably from one report to another. According to Johnston,[29] distention in the upper abdomen with tenderness and rigidity confined to the lower abdomen is the usual finding. In his series of five cases the most constant and distressing symptom was acute meteorism. Montgomery[15] stated, on the contrary, that distention is usually below the umbilicus. Lipshutz and Lowenburg[14] said that rigidity appears early and is the most characteristic sign of the disease. Olivier and Léger[31] found abdominal defense neither very prompt nor very rigid. Cole[11] states that the intensity of the muscle spasm depends on the severity of the case and that distention usually does not appear until the third or fourth day. A contrast between the general appearance of the patient and the physical signs has impressed several observers, but whereas Montgomery wrote: "It is noticeable how much sicker the patient seems than the abdominal examination indicates," Lipshutz and Lowenburg pointed to the "great contrast between the benign appearance and the abdominal findings." Differing statements on the disease picture are understandable when one remembers that few observers have been able to check their findings on any large series of cases. A "doughy feel" on palpation of the abdomen has been mentioned by most writers who discuss the physical findings. After several days or weeks of illness, dulness on percussion and even a definite fluid wave may be perceived. If the intraperitoneal pus has become encysted, a mass may sometimes be palpated through the abdominal wall. On rectal palpation there is pain in Douglas's pouch.

The leukocyte count is high, typically above 20,000, with polymorphonuclears comprising from 90 to 95 per cent.

According to Olivier and Léger,[31] it is rare that some one of the symptoms fails to give an "impression of dissonance," not found

in the same degree in peritonitis following appendicitis, even in children. Inequality in gravity between different symptoms constitutes, in their opinion, an essential element of the diagnosis.

Some highly atypical cases have been reported. In Hymanson's[16] 10 weeks old patient the clinical picture suggested a severe meningismus associated with some type of gastro-enteric infection, or a congenital anomaly of the brain with a communicating hydrocephalus. The correct diagnosis could only be made at autopsy. In Uruguay, when Negro's[20] 9 year old patient was admitted for cardiac insufficiency, ascites and cachexia, she had been running a fever of typhoid type for 22 days. Widal's reaction was positive early and again after 2 months. The diagnosis of pneumococcus peritonitis was made by paracentesis and confirmed at operation. Negro remains uncertain whether the final diagnosis was responsible for the entire disease picture or whether the pneumococcus peritonitis developed during the course of a typhoid fever. From Madagascar, Farinaud and Sappey[32] reported a case with insidious course continuing over 2 years, without fever, and simulating simple ascites. Autopsy revealed a generalized pneumococcus peritonitis.

The great majority of authors hold that a definite and assured diagnosis of pneumococcus peritonitis is possible only on finding the organism in the blood or in fluid obtained from the peritoneum, by paracentesis or laparotomy. A positive blood culture is important evidence but means a delay of at least 24 hours, which delay could easily spell the difference between life and death should the condition be due to appendicitis. A negative blood culture is of no significance especially in the first few days. Some recommend exploratory puncture as a safe and rational procedure while others reject it on the ground that the risk of perforating the intestine outweighs its usefulness.

Treatment

It will readily be seen that preoperative diagnosis is rare. Even when thought of as a distinct probability an accurate diagnosis is delayed by laboratory examination, smear of aspirated fluid or culture of material so obtained. By far the majority of observers, therefore, recommend early operation. A very few think that the diagnosis may be made from the clinical picture and recommend abstention from surgery until localization occurs and an abscess demands evacuation or certainly until defense barriers have been built up. The differential diagnosis from appendicitis, with or without rupture, is so difficult that, taking into consideration the much greater frequency of the latter, it seems far wiser not to delay operation. Upon opening the peritoneal cavity the diagnosis is readily suspected from the characteristic picture presented. Though there are

only a very few cases on record[28,33] in which pneumococcus peritonitis has existed with or followed ruptured appendix, the appendix should be located and carefully inspected. Usually no source of infection is found. The diagnosis made and fluid obtained for typing and culture, the object should be to get out of the abdomen with as little trauma and loss of time as possible. Some surgeons routinely remove the appendix while others are unwilling so to prolong the operative time or think it better not to risk the possibility, however slight, of superinfection.

The question of drainage has been given no little attention. It is now generally agreed that it is impossible to drain the peritoneal cavity. A drain acts as any other foreign body and stimulates not only its own encapsulation but also inflammation and certainly increases the possibility of postoperative obstruction. Any discharge which continues through or alongside a drain after 24 hours is the result of "an exudative phenomenon of the particular area of peritoneum irritated by the drain, contaminated by cocci that have traveled down the drain."[34] Admitting the impossibility of draining the peritoneal cavity, Montgomery[15] nevertheless advocated drainage to relieve intraabdominal pressure, which tends to increase the absorption of toxins by the peritoneum and even holds the opportunity for such drainage sufficient justification for the operation. Others insert a drain through the peritoneum only, apparently under the false principle that where there is pus a means for its escape should be provided. Still others drain the abdominal wall, justly assuming that 24 to 48 hours of such drainage may well prevent infection and sloughing of the wound. Believing that drainage of the peritoneal cavity in diffuse peritonitis is entirely illusory I did not drain the case which will presently be reported. If walled-off pus is encountered or if, after operation in the early stage the condition should go on, as is not infrequent, to the stage of encysted abscess formation adequate drainage should certainly be established.

The fluid obtained from the peritoneal cavity should be cultured and the type of pneumococcus ascertained as promptly as possible. If positive blood culture is obtained typing should be done at once. The type of pneumococcus responsible for the disease determined, specific serotherapy should immediately be instituted and sulfapyridine started in adequate dosage. In the earlier days of serum therapy disappointment was experienced. It is now clear that these disappointing results were due to lack of specificity in the serum used and too low dosage; there was too the usual reason for poor results with a new remedy, the tendency to try it out on moribund patients. Types I and II are those most frequently found in pneumococcus peritonitis, with a considerable predominance of type I. This latter fact led Syms[35] as early as 1918 and Liedberg[36] recently

to offer the advice that type I serum should be administered at once, without waiting for culture and typing, and changed later if found to be of the wrong type. Others advise a polyvalent serum to be used immediately in the same way. Type III appears to be very exceptional in pneumococcus peritonitis[50]: Rouhier, Lévy-Bruhl and Chevallier[37] report finding it in one case and state that it was present only 3 times in 45 strains of pneumococcus identified and typed by other authors in cases of peritoneal infection. Types of group IV are probably still more rare. Lowe[38] reported finding pneumococcus of this group in one of his two cases. It is interesting to note that in this case a trivalent pneumococcus serum was used before typing was done and gave no benefit. Since the work of Cooper and Rosenstein[39] in separating the different types included under group IV and in developing therapeutic antiserums for these types, it should be possible to treat pneumococcus infections of group IV with the specific serum. Cole[11] believes group IV to be frequent in pneumococcus peritonitis.

In this country the serum is given intravenously. In Europe it is given by various other routes—subcutaneously, intramuscularly and directly into the peritoneal cavity—as well as intravenously.

Rosenberg[40] advised injecting the serum under general or local anesthesia to avoid anaphylactic shock and diminish intensity of serum sickness.

Serum *must* be administered in dosage sufficient to obtain the desired response. The amount and frequency of the dose is determined entirely by the clinical picture. The following is the trend today: To a 7 year old child Doran[41] gave 117,000 units within 36 hours or less. Rappaport and Brescia[42] gave to a 5½ year old child 450,000 units (type I) distributed over 4 days (3 times daily); 60,000 units of types I and II had been given before the type was determined. Newell[9] gave to a 6 year old 295,000 units at two-hour intervals, distributed over 12 hours. Cooksey[19] gave to a 9 year old 80,000 units in a period of 12 hours, dividing it into 3 doses. In France, as early as 1934, Funck-Brentano[1] was advising 50 to 100 c.c. (60,000 to 120,000 units), half by muscle and half by vein. Thomas[2] at Guy's Hospital, London, gave to a 6 year old 100,000 units in the course of 3 days, using the intraperitoneal route. Liedberg[36] gave to a 4 year old 75,000 units intravenously and 25,000 units intraperitoneally in the course of 2 days. Heiberg and Vammen[43] gave to a 14 year old boy 120,000 units intravenously in the first 4 hours following operation and 36 hours after operation another 40,000 units. In another case they administered 170,000 units intravenously in 18 hours. They recommended dosage of 200,000 units in young children and 300,000 to 400,000 for older.

In all the above cited cases there was recovery. In the cases of Doran[41] and of Cooksey[19] no operation was performed, the organism and its type being ascertained from blood cultures. In all the other cases laparotomy was done for diagnosis before serotherapy was started. In one case serum was given on the second day from onset; in three cases, on the third day; in one case, on the fourth; in one, on the fifth, and in Cooksey's and Doran's cases six and seven days elapsed before serum treatment was instituted. It is not easy to evaluate the effect of the serum. On the one hand, in half the cases the first three days of illness, which are usually considered the period of greatest danger, had passed before serum was administered and the patients might thus be thought of as candidates for recovery with or without specific treatment. But in Schaudig's[44] two cases (not included above because they do not illustrate modern high dosage) serum was given for the reason that the patient was doing badly, in one case 15 days after early operation and in the other on the fourth day from onset, when the patient was in a "catastrophic" condition; and in both these cases the patients improved, in one case "strikingly," from the first dose of 30,000 units and with one or two further doses the improvement held and the patient went on to recovery.

If a patient with pneumococcus peritonitis survives the initial onslaught in the first few days, the illness follows one or another of certain fairly well defined courses, the general pattern of which does not appear to be greatly altered by operation or medical treatment. The temperature falls, sometimes sharply, and a period of improvement sets in; this improvement may continue without serious interruption, but more often it stops at a stage short of recovery, where it stays, it may be only for a day or so, it may be for weeks, after which symptoms, including high temperatures, return and the clinical picture becomes one of abscess formation. From this point, the course may again become benign, but usually operation is necessary to evacuate the intraperitoneal abscess, after which definite recovery may be looked for. At any point in this progress, the condition may take a turn for the worse to result in death.

The effect of serotherapy on this course seems to be that in cases that respond well the temperature reacts promptly and drastically, the general condition is improved and the chances of smooth recovery and survival are increased. In several of the cases cited above recovery was continuous and smooth from the first improvement which followed promptly on the administration of the serum. In other cases, early improvement was succeeded by renewed elevation of temperature and return of symptoms, which, however, yielded to repetition of the dose of serum. In still other cases intraperitoneal abscess formed and had to be evacuated before the final

recovery process set in. The rapid fall in temperature is perhaps the most impressive feature: in Cooksey's[19] case the temperature fell from 103.8 to 97.4 within 12 hours of the completion of the divided dose; in Newell's[9] case from 104.6 to 99.4 in 24 hours; in Thomas'[2] case from 104.4 to 100.4 in 4½ hours and to 98.9 in another 4 hours. With the practice of giving type I serum or types I and II serum immediately without awaiting culture and typing it may be possible to save many more lives.

In 1939, Barnett, Hartmann, Perley and Ruhoff[52] reported 5 cases of pneumococcus peritonitis in children treated with sulfapyridine both alone and in combination with specific serotherapy and conclude, "if definite improvement should not occur in 24 to 36 hours, specific serum therapy, if available, should be instituted if the clinical condition indicates its use." Later in 1939, Ladd, Botsford and Curnen[53] advised in peritonitis due to pneumococcus in children sulfapyridine therapy and intravenous administration of type-specific antipneumococcus serum. Teasdale[45] used the drug (under the British designation "M & B 693") together with 127,000 units of Felton's serum, distributed over 9 days, to a 10 year old child. Heiberg and Vammen[43] used sulfapyridine in 2 cases. In the first case it was stated return of symptoms, with meteorism, followed initial improvement after 115,000 units of serum. Twenty "tablets" of sulfapyridine were given and the patient appeared to be recovering when dyspnea developed, fever reappeared and the patient died. In the second case (that of the 14 year old boy already mentioned under discussion of modern dosage of serum) sulfapyridine was started, together with serum, shortly after operation on the fifth day of symptoms. Twenty-five "tablets" were given at intervals of 3 to 4 hours. Recovery set in promptly and was not interrupted.

From a study of recent publications, the following dosage of sulfapyridine every four hours may be recommended:

1 to 3 months, 0.15 Gm.

6 months to 1 year, 0.3 Gm.

5 years, 0.6 Gm.

12 years, 0.9 Gm.

Adults, 1.0 Gm.

Other forms of medical treatment which have been reported as successful in solitary cases are prontylin by Sager,[46] optochin base by Schaudig,[44] and taurocholate by Stefano.[47] General supportive treatment is, of course, essential and follows that used in any case of general peritonitis.

Report of Case

Mrs. L. H., aged 68, was admitted to the Jackson Memorial Hospital at 8:45 p. m., with a history of acute abdominal pain that had begun at 4 p. m. She had suffered nausea at onset, but no vomiting. She had passed seven profuse, foul stools, the last few of which were watery; these had been accompanied by intense colicky pain, which remained general throughout the abdomen. The pain had been greatly relieved after a hypodermic of morphine and atropine at 8 p. m.

No history or a previous similar attack could be obtained, nor a history to suggest peptic ulcer, diverticulitis or gallbladder disease. The menopause had occurred at 48, and there had been no vaginal discharge since. There were no symptoms referable to the genito-urinary or upper respiratory tract.

Examination: Mrs. H., being under an opiate, did not appear in great distress. She was uncommunicative but cooperative. She was thin but her muscles were firm. Temperature was 100.4, pulse 110, respiration 22, blood pressure 146/86. A slight systolic murmur was heard over the apex of the heart, but otherwise examination of the chest was negative. Hyperesthesia was general over the abdomen. The abdomen was not distended: 2 plus tenderness was present in the right lower quadrant, but the tenderness was distinctly less elsewhere. Rebound pain was general. Spasticity, present throughout, was more marked below the umbilicus where it approached rigidity. Peristalsis was present but diminished. On vaginal examination, pain was elicited deep in the cul de sac, but the uterus was normal in size and position, no abnormal masses were palpated, and there was no discharge from the cervix. Rectal examination was negative except for great tenderness in the cul de sac.

Complete Blood Count:

Hemoglobin	68%
Red Blood Count	4,020,000
White Blood Count	22,850
Schilling Differential:	
Polymorphonuclears (of which 70% were segmented and 24% band forms)	94%
Eosinophils	3%
Lymphocytes	3%

A notation was made of the possibility of acute appendicitis, perhaps with rupture, pneumococcus peritonitis, and diverticulitis with rupture, and immediate operation was advised: the working diagnosis was an acute condition of the abdomen.

The abdomen was opened through a right paramedian incision and at once a quantity of thin, slightly yellow, turbid, odorless fluid was encountered. A few flakes of fibrin were present over the cecum and ileum. The entire serosa was reddened and there was a peculiar slippery feel to the intestines. The appendix appeared normal except that it was involved in the generalized reddening. Exploration revealed no focus of infection. About 10 c.c. of the fluid together with several flakes of fibrin was sent to the laboratory. After removal of the appendix, the abdomen was closed in layers without drainage, all layers above the peritoneum being swabbed with ether.

The next day the temperature went to 103.2, the pulse to 130 and respiration to 24. That afternoon the report of the abdominal fluid was pneumo-

coccus, type II, and she was given 20,000 units of type II anti-pneumococcus serum. In ten hours the temperature had dropped to 101.2, and the pulse to 96. Twelve hours later the temperature had dropped to 99.6 and from then on recovery was uninterrupted. She was discharged as cured on the twelfth day.

Blood culture taken immediately after operation was negative.

Comment

1. Herewith has been reported a case of primary pneumococcus peritonitis in a 68 year old woman; only one other case of equal age could be found in a careful search of the literature.

2. Speedy cure was obtained by the use of type-specific anti-pneumococcus serum only. The prompt identification of the organism and its type was a vital factor in treatment.

3. Pneumococcus peritonitis, primary or secondary, is rare in the Miami area, as indicated by the finding of only the one case in approximately 150,000 admissions to the two largest hospitals there. One other case was found which fulfilled the clinical and operative picture but culture on the third postoperative day resulted in the finding of only staphylococci.

Conclusions

1. The mortality due to pneumococcus peritonitis can and should be markedly reduced by its prompt recognition clinically, at operation and in the laboratory and by therapy of type-specific antipneumococcus serum combined with sulfapyridine.

2. Diagnosis can almost always be made certain by laboratory examination of the fluid obtained from the peritoneal cavity by paracentesis, either abdominal or vaginal, or by operation.

3. It is the author's opinion that operation is indicated in the early stages if only for the purpose of differential diagnosis. Incision should be such as to allow thorough exploration of the peritoneal cavity, and should be closed without drainage except of the abdominal wall.

4. Modern accepted dosage of both type-specific antipneumococcus serum and sulfapyridine has been outlined. If sulfapyridine cannot be given orally it should be given parenterally. It is important that sufficient quantities of both the serum and drug be given; the clinical course is the guide as to the total amounts indicated. It is equally important that the above therapy be started as early in the disease as possible.

References

1. Funck-Brentano, Paul: La péritonite généralisée à pneumocoques, Clinique *29:* 267 (Oct.) 1934.

2. Thomas, A. E.: A Case of Pneumococcal Peritonitis, Guy's Hosp. Gaz. *53:* 21 (Jan. 28) 1939.
3. Mathieu, P., and Davioud, J.: Les péritonites généralisées à pneumocoques chez l'enfant, Presse méd. *37:* 909 (July 13) 1929.
4. Silvestrini, Luigi: Il trattamento curativo della peritonite da pneumococco, Minerva med., sez. scient. *26:* 465 (April 7) 1935.
5. Hetterich, Josef: Die Pneumokokkenperitonitis bei Erwachsenen. Inaug. Diss., Wurzburg, 1927.
6. Williams, Stanley: Pneumococcal Peritonitis in Children, Med. J. Australia *1:* 506 (April 1) 1939.
7. Drachter, Richard: Pneumokokkenperitonitis, Ztschr. f. ärtzl. Fortbildung *32:* 620 (Nov. 1) 1935.
8. Schaanning, C. K.: Ueber Pneumokokkenperitonitis, Acta chir. Scand. *77:* 256, 1935.
9. Newell, E. T., Jr.: Primary Streptococcus and Pneumococcus Peritonitis in Children. A Study of Sixty-one Cases with Report of Two Interesting Recoveries, Surg., Gynec. & Obstet. *68:* 760 (April) 1939.
10. Horine, C. F.: Pneumococcus Peritonitis: An Analysis of Seven Cases, Ann. Surg. *102:* 391 (Sept.) 1935.
11. Cole, W. H.: Pneumococcus Peritonitis, Surgery *1:* 386 (March) 1937.
12. Bass, M. H.: Pneumococcus Peritonitis, Med. Clinics N. America *19:* 847 (Nov.) 1935.
13. Fricke, Erich: Pneumococcus Peritonitis, Am. J. Surg. *8:* 48 (Jan.) 1930.
14. Lipshutz, Benjamin, and Lowenburg, Harry: Pneumococcic and Streptococcic Peritonitis: Report of Twenty-Three Cases in Infancy and Childhood, J. A. M. A. *86:* 99 (Jan. 9) 1926
15. Montgomery, A. H.: Primary Pneumococcus Peritonitis in Children, Surg., Gynec. & Obst. *41:* 798 (Dec.) 1925.
16. Hymanson, A.: Pneumococcic Peritonitis: Report of a Case with Necropsy, Arch. Pediat. *47:* 643 (Oct.) 1930.
17. Sostegni, Alfredo: Considerazioni sul trattamento chirurgico delle peritoniti da pneumococco, Arch. ed Atti della Soc. ital. di chir. *39:* 1128, 1933.
18. Elkin, D. C.: Pneumococcic Peritonitis, Arch. Surg. *18:* 745 (Feb.) 1929.
19. Cooksey, W. B.: Serum Treatment of Pneumococcus Peritonitis, J. Michigan State Med. Soc. *36:* 232 (April) 1937.
20. Negro, R. C.: Particularidades de un caso de peritonitis a neumococos, Arch. de pediat. del Uruguay *9:* 156 (March) 1938.
21. Van Dam: Cited by Bass. See Ref. 12.
22. Sims: Cited by Bass. See Ref. 12.
23. Ryan, T. J.: Primary Pneumococcal Peritonitis, Pennsylvania M. J. Vol. P. 1930.
24. Obadalek: Cited by Johnston. See Ref. 29.
25. Marnierre, de la: Péritonites à pneumocoques après accouchement, Mém. de l'Acad. de chir. *63:* 774, 1937.
26. McCord, J. R.: A Report of Two Cases of Pneumococcic Peritonitis Following Normal Labor, Am. J. Obst. & Gynec. *16:* 272, 1928.
27. Obadalek: Cited by Bass. See Ref. 12.
28. Suiffet, W. R., and Campo, J. C. del: Peritonitis neumococcica del adulto, Arch. uruguayos de med. cirug. y especial. *12:* 448 (April) 1938.
29. Johnston, R. C.: Pneumococcic Peritonitis: Report of 5 Cases, Am. J. Surg., n. s. *33:* 238 (Aug.) 1936.
30. Pederzoli, P.: Contributo allo studio delle peritoniti pneumococciche, Gior. veneto di sci. med. *13:* 185 (March) 1939.
31. Olivier, Claude, and Léger, Lucien: Traitement actuel de la péritonite à pneumocoques, Bull. gén. de thérap. *189:* 104, 1939.
32. Farinaud and Sappey: Péritonite à pneumocoques à évolution apyrétique et d'allure chronique, Bull. de la Soc. de pathol. exotique *32:* 239, 1939.
33. Mathieu, P.; Duchon and Davioud: Péritonite généralisée à pneumocoque, Bull. Soc. de pédiat. de Paris *25:* 134 (March 15) 1927.
34. Tenopyr, Joseph, and Shafiroff, B. G. P.: Peritoneal Physiology and Abdominal Drainage, Med. Rec. *144:* 543 (Dec.) 1936.

35. Syms, Parker: Pneumococcus Peritonitis, Ann. Surg. *67:* 265 (March) 1918.
36. Liedberg, N.: Serumbehandlat av pneumoccperitonit. Nordisk Med. *2:* 1045 (April 8) 1939.
37. Rouhier, Lévy-Bruhl and Chevallier: Pelvi-péritonite à pneumocoque III (Pneumococcus mucosae). Colpotomie, sérothérapie spécifique locale; guérison, Mém. de l'Acad. de chir. *63:* 1148, 1937.
38. Lowe, H. A.: Pneumococcic Peritonitis, J. Missouri M. A. *33:* 353 (Sept.) 1936.
39. Cooper, Georgia, et al.: The Separation of Types among the Pneumococci Hitherto Called Group IV and the Development of Therapeutic Antiserums to these Types. J. Exper. Med. *49:* 461 (March 1) 1929. The Further Separation of Types among the Pneumococci Hitherto Included in Group IV and the Development of Therapeutic Antisera for these Types. Ibid. *55:* 531 (April 1) 1932.
40. Rosenberg, Hildegard: Zur Wirkung des Peritonitis-Serum. Müench. med. Wchnschr. *85:* 761 (May 20) 1938.
41. Doran, F. J.: A Case of Pneumococcic Peritonitis with Recovery, Ohio State M. J. *35:* 609 (June) 1939.
42. Rappaport, H., and Brescia, M. A.: Pneumococcus Peritonitis, Arch. Pediat. *52:* 766 (Nov.) 1935.
43. Heiberg, B., and Vammen, B.: Om Pneumokokkperitonitis. Spec. m. Henblik paa Serumbehandlung, Ugeskrift for Laeger *101:* 871 (July 27) 1939.
44. Schaudig, H.: Zur Behandlung der Pneumokokkenperitonitis, Zentralbl. f. Chir. *60:* 1344 (June 10) 1933.
45. Teasdale, John M.: Pneumococcal Peritonitis in Bilateral Pneumococcal Empyemata, Brit. M. J. *1:* 1179 (June 10) 1939.
46. Sager, W. W.: A Case of Pneumococcal Peritonitis Treated with Prontylin, Med. Ann. Dist. Columbia *7:* 99 (March) 1938.
47. Stefano, S. De: Pleuro-peritonite purulenta da diplococco: contributo all terapia, Pediatria *40:* 713 (July) 1932.
48. Owens, W. D.: Primary Pneumococcic Peritonitis in an Adult: Prompt Cure by Sulfapyridine Therapy, Am. J. Obst. & Gynec. To be published.
49. Nuckols, H. H., and Hertig, A. T.: Pneumococcus Infection in Genital Tract in Women Especially during Pregnancy and Puerperium, Am. J. Obst. & Gynec. *35:* 782-793 (May) 1938.
50. Bennett, A. W., and Mengert, W. F.: Pneumococcus, type III, Associated with Pelvic Inflammatory Disease, Am. J. Obst. & Gynec. *39:* 142-144 (Jan.) 1940.
51. Tompkins, P.: Pneumococcus Pelvic Infection in Women, Am. J. Obst. & Gynec. *31:* 70-78 (Jan.) 1936.
52. Barnett, H. L.; Hartmann, A. F.; Perley, A. M., and Ruhoff, M. B.: The Treatment of Pneumococcic Infections in Infants and Children with Sulfapyridine, J. A. M. A. *112:* 518-527 (Feb. 11) 1939.
53. Ladd, W. E.; Botsford, T. W., and Curnen, E. C.: Primary Peritonitis in Infants and Children: A More Effective Treatment, J. A. M. A. *113:* 1455-1459 (Oct. 14) 1939.

PATHOLOGY CAUSING THE SCIATIC SYNDROME

EXUM WALKER, M. D.
Atlanta

THE fundamental mechanism causing sciatica is now well known. The treatment of the individual case can be planned in accordance with the existing pathologic condition.

The purpose of this presentation is to stress two points: first, to emphasize the mechanism by which the signs and symptoms of sciatica are produced, and, second, to present some of the various pathologic conditions which cause this syndrome.

Until recently the cause of sciatica was not known. An important contribution was made by Mixter in 1933. He reported nineteen cases in which the extruded portion of a ruptured intervertebral disc was shown to be compressing the spinal nerve roots. Since then, neurosurgeons have reported many such cases relieved of their pain by surgical removal of a herniated disc. The study of these cases has served to explain for the first time the mechanism by which the various signs and symptoms of the sciatic syndrome are produced. The interest thus created has led neurosurgeons to discover an increasing variety of lesions causing sciatica.

The fundamental mechanism producing the sciatic syndrome is mechanical compression of the lower lumbar or sacral spinal nerve roots within the spinal canal. The lesion is usually in the lower portion of the lumbar spinal canal, but may be as high up as the twelfth thoracic level. In my experience, the pathologic condition has been visualized at operation in more than a hundred fifty cases. A lesion of an intervertebral disc was most commonly encountered. This varied from an excessive bulging of an intact disc to an actual rupture with extrusion of a portion of the disc substance into the spinal canal. In other cases, nerve compression was found to be due to hypertrophy of the ligamentum flavum, various types of tumors, arthritis, fractures, spondylolisthesis, and a variety of other conditions.

The illustrations serve to explain how the varied lesions compressed the nerve roots and produced the clinical pictures which were so strikingly similar.

SUMMARY

Sciatica is caused by mechanical compression of the lower lumbar or sacral spinal nerve roots in the spinal canal. Some illustrations are presented to demonstrate the variety of pathologic lesions which have been shown to produce the sciatic syndrome.

From the Department of (Neuro) Surgery, Emory University School of Medicine.

Read before the Postgraduate Surgical Assembly (the eleventh annual meeting) of The Southeastern Surgical Congress, Birmingham, March 12, 1940.

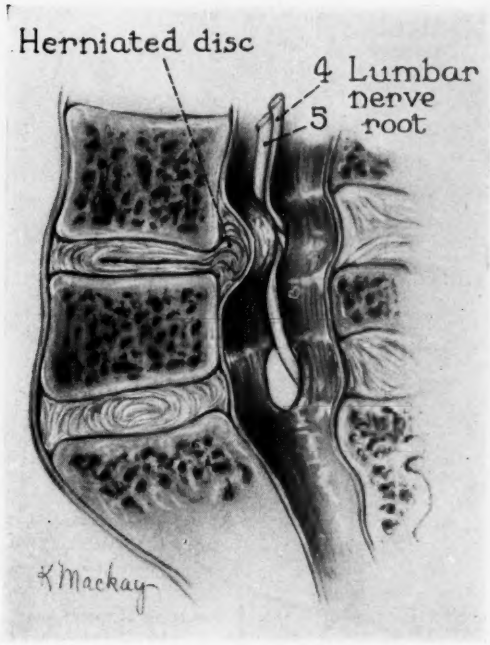

Fig. 1. Rupture of an intervertebral disc causing spinal nerve root compression.

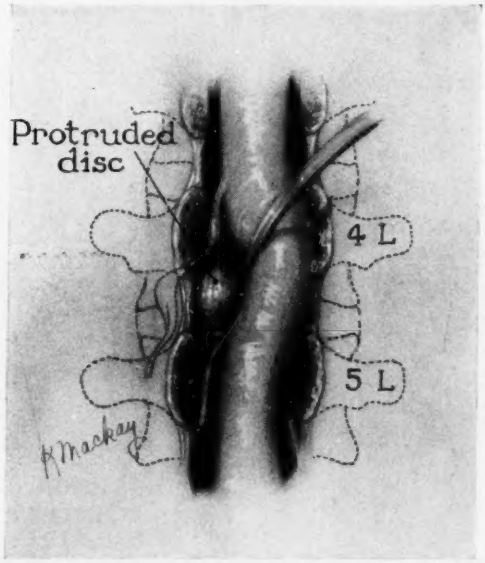

Fig. 2. Dorsal view of herniated intervertebral disc.

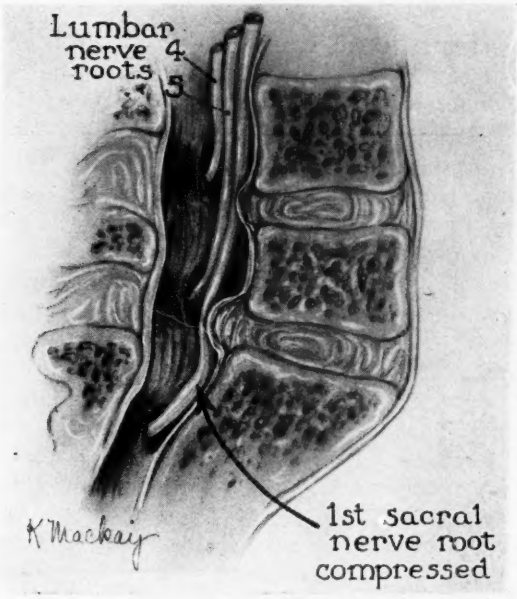

Fig. 3. Nerve root compression by excessive bulging of intact intervertebral disc.

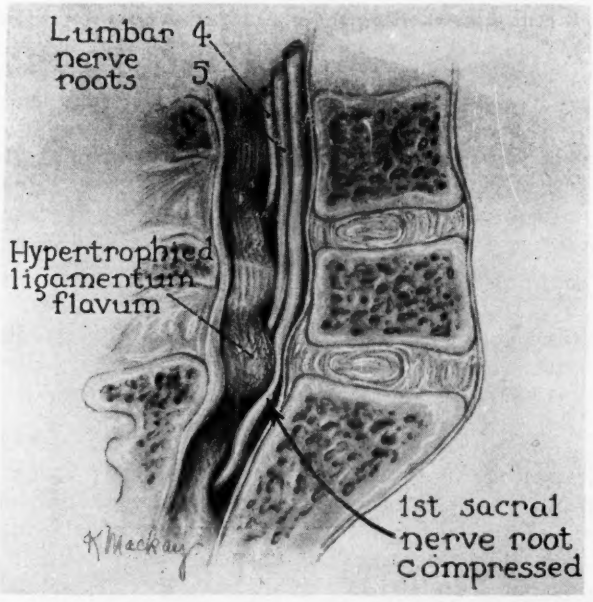

Fig. 4. Hypertrophy of ligamentum flaxum compressing a root against a normal disc.

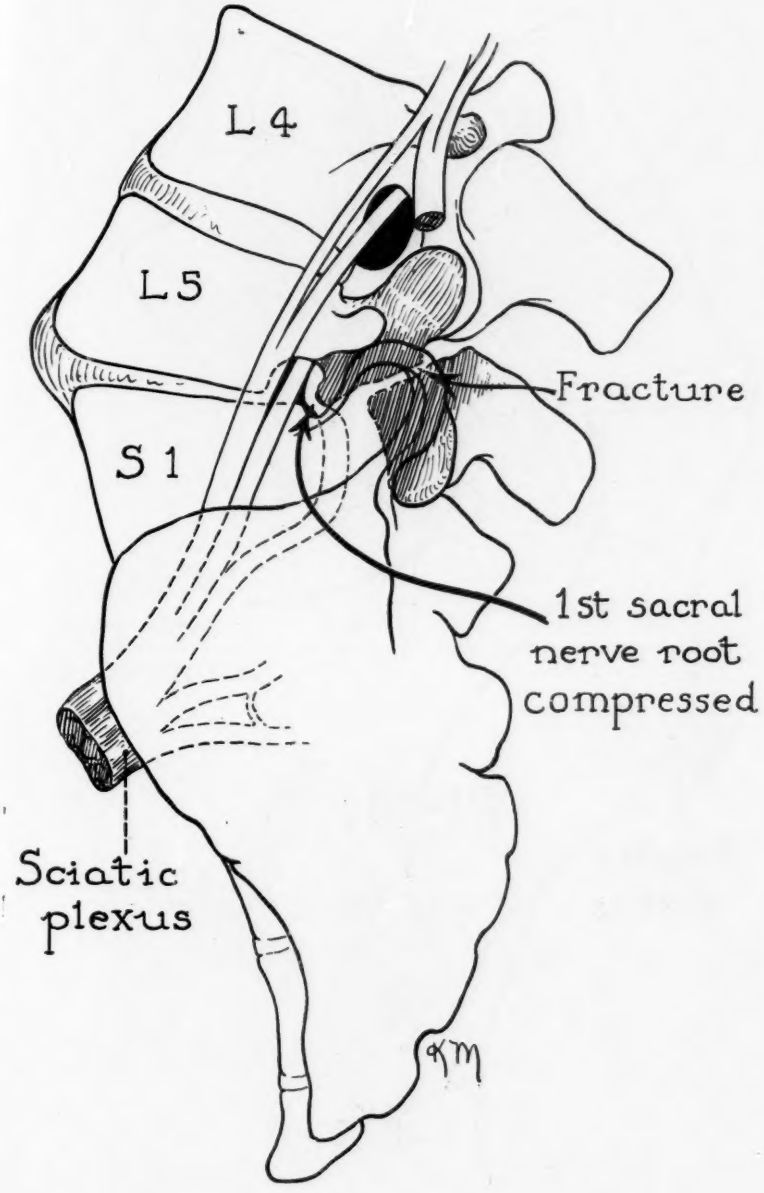

Fig. 5. Spondylolisthesis caused by fracture of the laminal arch with nerve root compression.

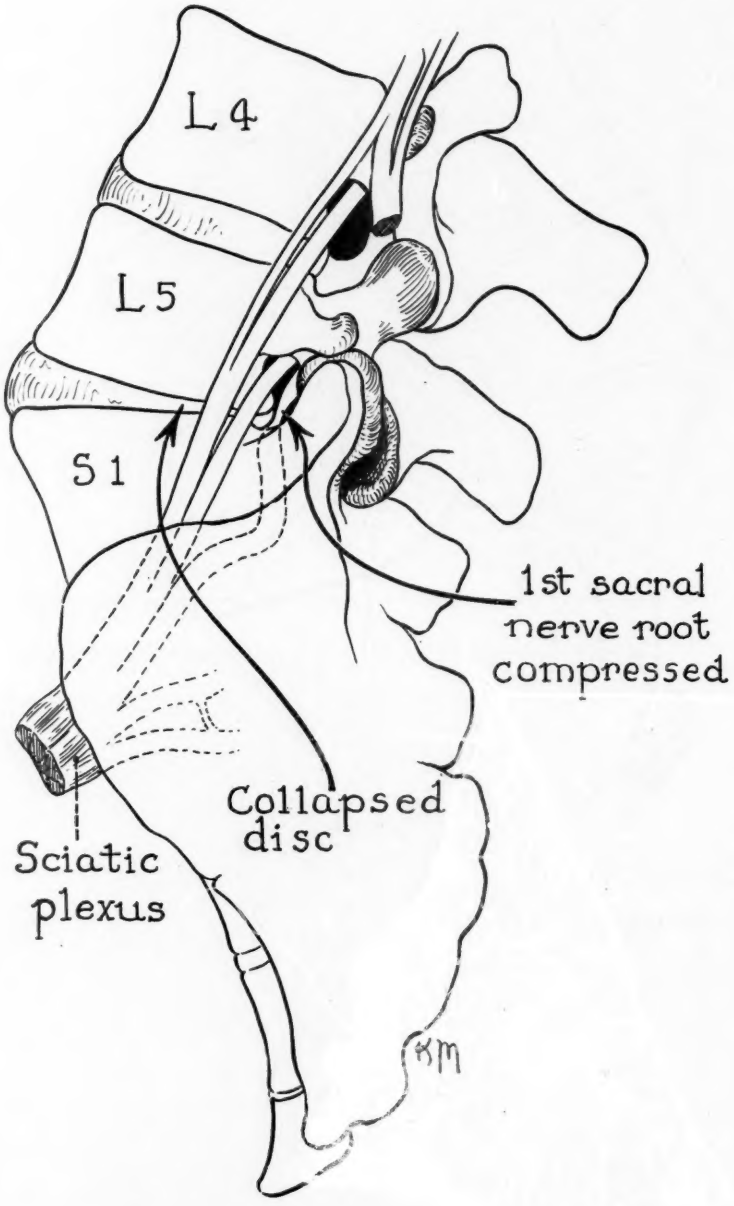

Fig. 6. Collapse of disc with nerve root compression between the body of the fifth lumbar vertebra and the articular facet of the sacrum.

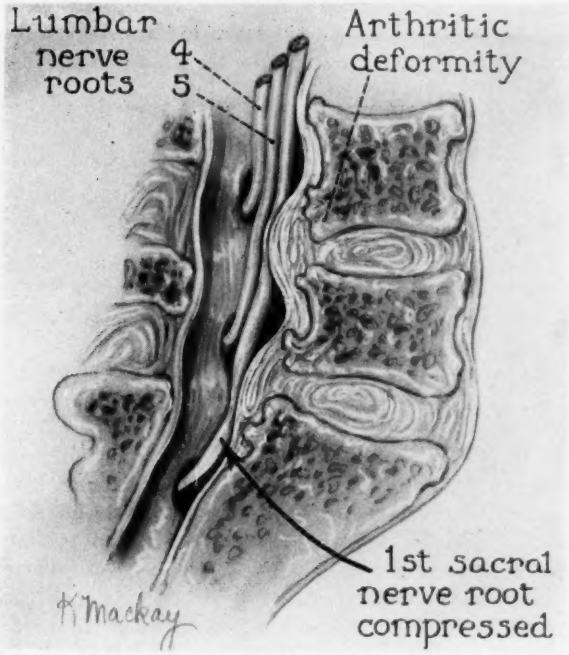

Fig. 7. Osteoarthritis of the spine causing nerve root compression at multiple points.

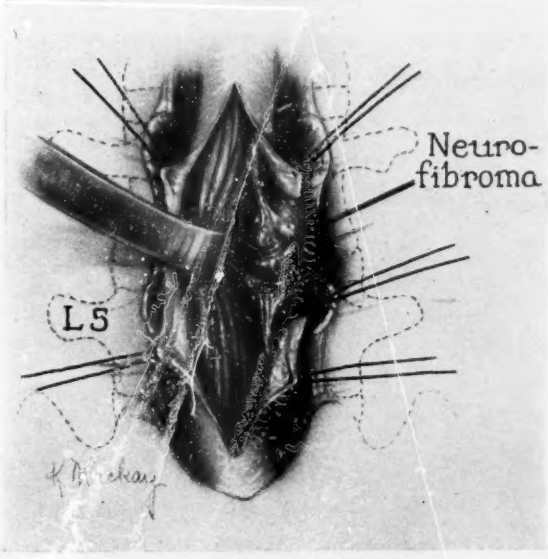

Fig. 8. Neurofibroma causing sciatica.

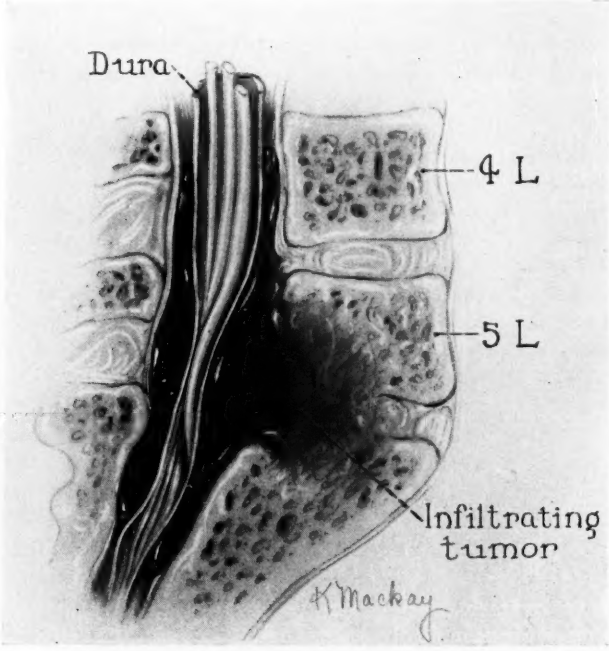

Fig. 9. Extradural tumor (osteochrondroma) causing sciatica of four years duration.

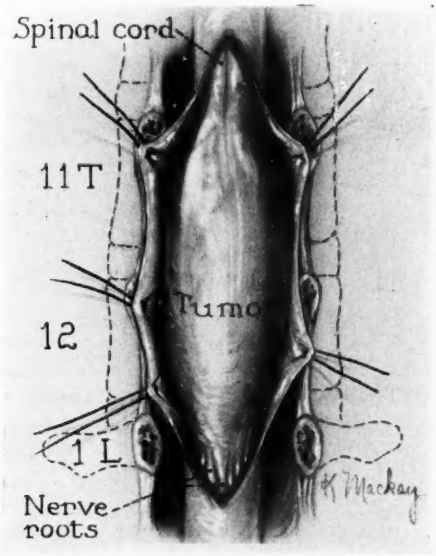

Fig. 10. Spinal cord tumor causing sciatica for weeks before other symptoms developed.

SPINAL ANESTHESIA

Observations after Ten Years Experience
A Report of More than 7,000 Cases

MORTON J. TENDLER, M. D., F. A. C. S.
Memphis

HISTORY

THE reports of Pitkin[1] in 1927 and 1928 precipitated a renewed interest in spinal anesthesia throughout this country and Europe. It was a renewed interest because spinal anesthesia had had two other trials since the beginning of the twentieth century. The first began with the publication of the work of Bier[2] and of Matas[3] in 1899. The feeble flicker of enlightenment soon perished due to the well known human quality—fear of the unknown. The second began with the first World War and ended almost with it. This era, too, collapsed rather suddenly due mainly to impoverished knowledge of cerebrospinal anatomy and physiology as well as a reassertion of the human quality previously alluded to. It should not be forgotten however that a faithful few continued to do much with spinal anesthesia during all these years. They worked quietly and carefully. They devised better technic, sought purer, more efficient and less toxic drugs. Foremost among them were Babcock,[4] Leriche,[5] LeFilliatre[6] Jonnesco[7 4] and Labat.[5] To them we owe the establishment of spinal anesthesia as another good anesthetic to add to our greatly enlarging armamentarium against pain.

In tracing the present decade's popularity of spinal anesthesia, its history could be divided into four periods:

1. Period of Discovery
2. Period of Experiment
3. Period of Expansion
4. Period of Recognition

1. Period of Discovery

1851 Pravaz invented the hypodermic syringe
1859 Niemann isolated the alkaloid, cocaine
1862 Schraff discovered cocaine's anesthetic properties
1884 Koller introduced cocaine clinically as an anesthetic
1885 Corning produced first spinal anesthesia with cocaine
1891 Quincke introduced technic for lumbar puncture
1894 Corning advocated spinal anesthesia for surgery

2. Period of Experiment

1899 Bier reported first cases of surgical spinal anesthesia
1899 Tuffier first to perform abdominal surgery with spinal anesthesia

From the Division of Surgery, University of Tennessee, Memphis, and the Departments of Surgery of the John Gaston and Baptist Memorial Hospital, Memphis.

1899 Matas first to report surgical spinal anesthesia in U. S. A.
1902 Morton first to report thoracic spinal anesthesia
1902 Le Filliatre first to report total spinal anesthesia
1904 Fourneau—synthesized stovaine
1904 Babcock began his work with stovaine
1905 Einhorn—synthesized novocain

3. Period of Expansion

1907 Barker first to report on gravity control—England
1909 Jonnesco popularized zonal anesthesia
1912 Babcock introduced gravity control in U. S. A.
1919 Hepburn introduced heavy spinal solutions
1921 Labat introduced barbotage
1927 Pitkin first presented spinocain
1929 Stout introduced volume control

4. Period of Recognition

1930-1940 Spinal anesthesia in use in the majority of good hospitals

Due credit to the man who is mainly responsible for the great wave of enthusiasm which swept across America in this "Period of Recognition" would not be amiss at this time. He is Dr. George P. Pitkin of Bergenfield, New Jersey. Maxson[9] of Seattle called him "a master technician and a supersalesman." He should be called the St. Paul of spinal anesthesia.

This Series

The series of spinal anesthesias to be reported in this paper can be divided into two parts. The first part constitutes those cases carefully followed in a prescribed manner as outlined in a previous paper in 1929.[10] The anesthetists at the John Gaston Hospital, the teaching institution of the University of Tennessee, have kept a faithful record (see fig. 1) as follows: Date of operation; name; age; race; type of operation; operator; recorder; the blood pressure (before and after operation, and the maximum and minimum during operation); the pulse rate (in the same manner); spinal anesthetic used, amount used, and interspace punctured; any supplementary anesthetics used, how much and how long; total time of spinal anesthesia; total time of operation; operative condition of patient, before, during and after; remarks on the subjective and objective reactions during operation; and lastly, postoperative course in relation to the spinal anesthetic. In this part there are 4,731 cases. The second part consists of the spinal anesthetics administered by the Surgical Staff of the Baptist Memorial Hospital both on the Private and Charity Services. This part totals 3,215 spinal anesthetics, over 1,100 of which were administered by me. The 1,100 cases comprise a series of private cases in the services of Dr. J. L. McGehee and myself. Only postoperative complications

and mortality will be considered in the second part. The two parts of the series have run concurrently from 1929 to Nov. 1, 1939, the Charity Service at the Baptist Memorial Hospital being under the supervision of the University of Tennessee Medical School faculty. It should be mentioned here that many members of the Surgical Division of the University of Tennessee practice at the Baptist Memorial Hospital.

TABLE 1

John Gaston Hospital	4,731
Baptist Memorial Hospital	3,215
TOTAL	7,946

The spinal anesthetic agents employed at times changed in both hospitals. Both series began with procaine crystals, using this drug exclusively during the first few months, then both hospitals switched to Pitkin's spinocain for about two years. For the next six years procaine was used in the great majority of cases using the American made crystals or the French neocaine. For the past two years metycaine has been the most popular. However, there are scattered cases of spinocain, pontocaine, nupercaine and quite a number of procaine. There are men in the same office whose tastes differ. For instance, at the present writing, Dr. McGehee, my senior colleague, and director of the Division of Surgery at the University of Tennessee, distinctly prefers metycaine. The writer has switched back to his first love, procaine.

The majority of the operations in both series, where spinal anesthesia was employed, were performed on the General Surgical Services. However, urology, gynecology and orthopedics have been contributing many cases in increasing numbers yearly.

The technics employed in the administration vary with the drugs employed. When procaine is used, the maximum dosage is 200 mg., while the average dosage still remains about 1 mg. per pound of body weight. Operations upon the lower extremities, external genitalia, perineum, anus and rectum require from 50 to 75 mg. For operations below the umbilicus 100 to 150 mg., and for upper abdominal procedures 100 to 200 mg., depending upon the length of anesthesia required, are employed. Not more than 3 c.c. of spinal fluid have been used as solvent in any case, the average being 2 c.c. When metycaine is used the dosages have not been varied from those employed with procaine; the minimum being 50 mg. and maximum 200 mg. Equal parts of the metycaine solution and spinal fluid are mixed and then injected. In both technics one half minute per cubic centimeter is the usual injection rate. The slower the injec-

tion, the slower is the diffusion and dilution; hence a more localized anesthesia and a longer one. Depending upon the operation, injections are made from the fourth lumbar to the twelfth thoracic interspace. The drug is injected in the lateral-horizontal position. Trendelenburg position of five degrees is used immediately after the injection, unless a small dose, 75 mg. or less, is employed as in perineal, anal or lower extremity surgery.

TABLE 2

Operative Complications

(John Gaston Hospital—4,731 cases)

	Per Cent
Nausea	16.3
Vomiting	9.7
Blood Pressure Changes	
(a) Stationary throughout	55.7
(b) Remained above first reading	14.0
(c) Dropped below first reading	30.3
Pulse Rate Changes	
(a) Stationary throughout	17.1
(b) Decreased	36.0
(c) Accelerated	47.8
Respiratory failure—Two cases, both recovered.	
Mortality—Three deaths in the operating room.	

TABLE 3

Anesthesia Records

(John Gaston Hospital—4,731 cases)

Degree of Anesthesia Obtained		Per Cent
1. Good (No pain at any time)		88.7
2. Poor (Traction pain; undue proprioceptive sensations; transitory pains)		10.1
3. Failure (No analgesia at operative site)		1.2
Supplementary anesthesias		7.6
1. Procaine infiltration	11.4	
2. Nitrous oxide—oxygen	12.0	
3. Ethylene	14.2	
4. Combinations (Ethylene-ether or nitrous oxide ether)	27.8	
5. Ether	34.6	
TOTAL	100	

Pitkin's technic is carefully followed where spinocain is employed. Jones' technic[11] was used in the few nupercaine anesthesias just recently employed.

In table 2 the operative complications reveal a low percentage of nausea and vomiting in contrast to other reports and experience in private practice. An important factor here is probably the great number of negro patients in this series. As a group they make better patients, are more tractable and more phlegmatic than white patients. Three negro patients appear to one white in this series.

TABLE 4

Postoperative Complications

(John Gaston Hospital—4,731 cases)

	Per Cent
Headache	4.2
Backache	0.69
Abducens paralysis (one case) 8 days duration	
Difficulty in swallowing (one case) 7 days duration	
Neuritis, traumatic, left leg (one case) 3 weeks duration	
Meningitis, etiology undetermined (one case) died	

Blood pressure and pulse changes are in accord with most observations reported. Blood pressure changes are not as alarming to the operator as they were in the earlier years, but rapid drops in blood pressure invariably precede nausea and vomiting. Thus, careful blood pressure readings may assist in obviating these troublesome operative complications.

Respiratory failure, occurring in two cases, both with normal pulse and blood pressure readings, was quickly combated with forced bag respiration of oxygen and carbon dioxide. Both patients made a good operative recovery.

The mortality statistics will be discussed further.

In table 3 it will be noted that there was a high percentage of analgesic failure (1.2 per cent). The main factor in successful spinal anesthesia technic is the anesthetist. In this series most of the spinal anesthetics were administered by the rotating interns on the surgical services. Inexperience in proper lumbar puncture technic as well as improper injection methods, therefore, are mainly responsible.

The greatest number of supplementary anesthesias were of the open ether method. Where the operations were prolonged and continued relaxation desired, open ether only could produce the degree

of inhalation anesthesia necessary to maintain it. This was particularly true of intra-abdominal surgery. In a few instances nitrous oxide-oxygen was employed in those cases where apprehension and fear seemed to play too strong a role. Spinal anesthesia is not a good anesthetic in the apprehensive or fearful.

In table 4 the most common postoperative complication recorded was headache. The headaches varied from mild to severe to intractable, from 24 hours to three months duration in one case. The vast majority lasted but two days postoperatively, and many might have been attributed to causes other than the spinal anesthetic or the lumbar puncture. Three cases of headache lasted longer than one week. One continued for six weeks and the longest three months. All were occipital and cervical type, relief only occurring in the recumbent position. The next most common complication was backache. However this symptom was transient, no patient leaving the hospital complaining of persistent backache due to the spinal anesthetic nor the lumbar puncture. It is surprising that there were not more instances of traumatic neuritis. The impinging of nerve roots, particularly of the cauda equina, occurs not infrequently in lumbar puncture. Apparently few of these traumas cause serious damage. The death due to meningitis will be presented in detail under mortality statistics.

Mortality Statistics

(John Gaston Hospital—4,731 cases)

Deaths in the operating room	3
Deaths, postoperative	1
TOTAL	4

Mortality rate—1:1178 cases.

Mortality statistics depend entirely upon the point of view of the statistician. It is very easy to make statistics do tricks in favor of the one who is compiling them. Those in favor of one particular group of statistics can make them stand up and shout "Aye!" Those in opposition can make them just as readily scowl and shake their heads with a loud "Nay!" In presenting the four cases whose deaths are directly connected with the administration of a spinal anesthetic as outlined above, a brief summary of each is presented:

CASE 1. O. C., a colored woman aged 19. Poro section for ruptured uterus. Blood pressure before operation 90/40. Pulse 200. Respiratory failure in five minutes, revived, operation continued. Died in fifty minutes.

CASE 2. G. G., negro aged 65. Reduction of fractured femur. Blood pressure before operation 140/80. Pulse 80. Respiratory failure in five minutes. Artificial respiration continued for one hour. Recovery.

CASE 3. D. S., negro woman aged 39. Strangulated umbilical hernia. Blood pressure before operation 130/70. Pulse 120. Due to extreme lordosis, patient was left on a level plane for five minutes "to allow fixation of anesthetic." Blood pressure dropped to 60/40 in five minutes. Blood pressure imperceptible in fifteen minutes and respirations ceased at that time. All efforts at resuscitation to no avail.

CASE 4. J. B., negro aged 54. Three days after operation for multiple anorectal fistulas developed typical picture of cerebrospinal meningitis. The spinal fluid contained 5,000 cells with 57 per cent polymorphonuclears per cu. mm. Globulin was 4 plus. Gram stains were negative for organisms. Spinal fluid cultures were also negative. The patient died on the fourth postoperative day with pulmonary edema, right facial paralysis and coma.

In discussing these cases, Case 1 was obviously a poor anesthetic risk, and some of the statisticians in the "Aye!" group would not think of considering this case a spinal death. However, the patient died under spinal anesthesia (0.5 c.c. of heavy spinocain). This fact cannot be hurdled. It is obvious, however, that she would have been a poor operative risk under any anesthesia. Case 2 was definitely a spinal anesthetic fatality. He was in good condition before the anesthetic was given (2 c.c. spinocain, light). Either idiosyncrasy to the drug or too high a diffusion was responsible. Case 3: Though this patient was considered a bad operative risk, apparently spinal anesthesia seemed to be indicated. This death, too, is quite obviously a spinal fatality. The added toxicity of the spinal anesthetic drug (metycaine 150 mg.) to an already toxic state, the result of four days of intestinal obstruction, was just enough to push her over the brink. Case 4 presents a problem. No organisms were obtained on repeated smears and cultures. Yet definite meningitis followed very soon after the spinal anesthetic. The injection of any substance, even air, into the subarachnoid space would call forth an exudation of white cells. (In this case, only 50 mg. of novocain). Even a meningismus might follow such a procedure. But no one ever died from meningismus. Could death have been due to a "toxic meningitis" due to the novocain?

In the Baptist Memorial series of 3,215 cases there was one death, and that one in the first few hundred administrations (1930). A summary of the case follows:

Mrs. C. W., aged 30, weight 340 pounds. Preoperative diagnosis, acute generalized peritonitis due to appendicitis with rupture. Very toxic. Temperature was 102.8 and pulse 140. Too much fat on arms to take blood pressure readings. Patient died within five minutes after administration of 100 mg. of novocain.

Spinal anesthesia, as well as any other anesthesia, might have been contraindicated in this very obese patient. However, it must be included in impartial tabulation.

No effort was made, in the Baptist Hospital series, to obtain detailed information as to operating room and postoperative complications. In the series of Dr. McGehee's cases and the writer's, no untoward operating room complications occurred. There were cases of nausea, vomiting and depressed blood pressure, as commonly as reported in numerous detailed reports, probably more than in the John Gaston Hospital series. Postoperatively, there was one case of traumatic neuritis of the right leg, which resulted in a foot-drop which lasted almost three months. There were three severe headaches, lasting from two weeks to six weeks.

Discussion

In presenting the statistics of the John Gaston Hospital series, it must be remembered that this complication is not the result obtained by a single individual. Over 120 individuals during the past ten years administered the anesthetics herein recorded. It is surprising that there were so few anesthetic failures as well as anesthetic deaths. The operating room and postoperative complications, too, are much lower than might have been anticipated. The majority of the surgery, as well as the administrations of most of the spinal anesthetics, is done by the resident and intern staff. Innumerable reports in the present day literature assure us that general hospital series where numerous operators or interns are involved in the compilations of a similar series, the number of complications as well as the mortality rate increases in direct ratio to the number of individuals involved. At Charity Hospital in New Orleans, Veal and Van Werden[12] reported 30 deaths in 33,000 cases in the operating room—all due directly to the spinal anesthetic, while Babcock reports no deaths in his last 10,000.

No effort has been made in this paper to extol the value of spinal anesthesia. A moderately large group of cases has been gathered in an effort to learn what dangers lurk in the use and abuse of an anesthetic agent which has just about reached adulthood. It is only by the unbiased presentation of such facts can efforts be made to attain more perfect records and results. Human history records the facts only too many times where false security has caused the downfall not only of individuals but of nations. The surgeons who use spinal anesthesia believe the advantages as outlined in this paper can be further minimized by further search for more innocuous drugs, better spinal technic and more careful detail in the selection of prospective surgical and anesthetic risks.

Summary

1. The history of spinal anesthesia is traced through four periods—discovery, experiment, expansion, and recognition.

2. The statistics in 7,946 cases are presented.

3. Five deaths due to spinal anesthesia are recorded.

4. Operating room and postoperative complications attributable to spinal anesthesia are tabulated and discussed.

Conclusions

1. Spinal anesthesia has survived its many trials and vicissitudes because its advantages have far outweighed its disadvantages.

2. The skill in its administration is on the increase due to better knowledge concerning anesthetic drugs, the physiology of the cerebrospinal system and the spinal fluid, and the establishment of better technics.

3. Further improvements in spinal anesthesia will be due to the discovery of better drugs as anesthetic agents, less nocuous yet producing long anesthesia.

4. Like ether in inhalation anesthesia, procaine (novocain, neocaine) is the safest spinal anesthetic.

5. The greatest boon to the patient lies in specialization in spinal anesthesia technic by surgeons under experienced teachers.

REFERENCES

1. Pitkin, G. P.: (A) Controllable Spinal Anesthesia, J. M. Soc. New Jersey *24:* 425-438 (July) 1927. (B) Controllable Spinal Anesthesia, Am. J. Surg. *5:* (new series) 537-553 (Dec.) 1928.
2. Bier, A.: Versuche uber Cocainisirung des Ruckenmarkes, Deutsche Ztschr. f. Chir. *51:* 361-369, 1899.
3. Matas, Rudolph: mentioned in news item, "Intraspinal Cocainization," J. A. M. A. *33:* 1659 (Dec. 30) 1899.
4. Babcock, W. W.: (A) Spinal Anesthesia. A Clinical Study of 658 Administrations, Pennsylvania M. J. *12:* 891-903 (Aug.) 1909. (B) Spinal Anesthesia in Fact and Fancy, Surg., Gynec. & Obst. *59:* 94-100 (July) 1934.
5. Leriche, R.: Spinal Anesthesia, Ann. Surg. *81:* 38-44 (Jan.) 1925.
6. LeFilliatre, G.: Precis de Rachianesthesie Generale, Paris, Libr. Le Francois, 1921.
7. Jonnesco, T.: Remarks on General Spine Analgesia, Brit. M. J. *2:* 1396-1401 (Nov. 13) 1909.
8. Labat, G.: Elimination of Dangers of Spinal Anesthesia, Am. J. Surg. *5:* (new series) 625-632 (Dec.) 1928.
9. Maxson, L. H.: Spinal Anesthesia, Philadelphia, J. B. Lippincott Company, 1938.
10. Tendler, M. J.: Spinal Anesthesia, Memphis M. J. *6:* 143-155 (July) 1929.
11. Jones, W. H.: Spinal Analgesia—New Method and New Drug—Percaine, Brit. J. Anaesth. *7:* 146-156 (July) 1930.
12. Veal, J. R., and Van Werden, B. D.: Mortality of Spinal Analgesia, Am. J. Surg. *34:* (new series) 606-610 (Dec.) 1936.

CARCINOMA OF THE DESCENDING COLON

T. A. Pressly, M. D., F. A. C. S.
San Antonio

AGE does not contraindicate surgery in malignant conditions of the colon since many of these patients can be sufficiently prepared to permit radical surgery, especially if it is done in multiple stages. They require a great deal of attention to the cardiovascular, renal and respiratory systems. A large reserve of glycogen should also be provided by feeding the patients glucose and carbohydrates several days before operation.

Many of these elderly persons seem inactive but yet they are unable to stay in bed any length of time. General weakness contributes to the high mortality rate which is to be expected.

Illustrative Cases

Case 1. Mr. J. S., aged 76, was admitted to the Medical and Surgical Memorial Hospital, September, 1939.

Previous History: He was operated upon May 14, 1939, for acute intestinal obstruction at another hospital. Previous to this, he had been constipated and this constipation had been getting constantly worse for two years. He frequently took laxatives in increasingly strong doses. At the first operation, the surgeon found the obstruction in the descending colon but the condition of the patient was such that he was unable to do more than a colostomy. The wound broke down four days later and after six days, was discharging fecal matter. The colostomy then closed itself, and a fecal fistula formed in this incision.

In August he was transferred to a second hospital where a resection of a portion of the terminal ileum was done. The wound broke down and on admission to the Medical and Surgical Hospital in September a portion of the cecum and two small knuckles of the small intestines were protruding in the wound. He was most uncomfortable. The skin of the abdomen was badly excoriated by the intestinal discharges. At first treatment consisted only of careful feeding and increasing exercise. His condition improved considerably and in October a barium enema showed a carcinoma above the sigmoid flexure.

On October 7, a preliminary modified Mikulicz operation was done in which the tumor was brought outside the abdomen where it was later cut off. This was a difficult dissection.

At the end of October he was permitted to go home with instructions to return later for the closure of the cecostomy. This was done in November. He then began to have a few normal bowel movements and the colostomy opening at the site of the Mikulicz operation became a great deal smaller. Since then he has undergone prostatectomy. He is now in good condition and walks around and enjoys most of the normal activities of anyone his age.

Read before the semi-annual meeting of the Texas Surgical Society, Dallas, April 1 and 2, 1940.

CASE 2. Mrs. W. H. S., aged 74, was first admitted to the Medical and Surgical Memorial Hospital, July 3, 1939.

Previous History: Four days before admission she had begun to have severe pain in the abdomen which was at first generalized and then settled in the left lower quadrant.

On admission a tender mass about the size of an orange was found in this area. She stated this had not been present before her present illness. Fever and marked leukocytosis were present. The mass was thought to be an abscess secondary to perforation of a diverticulum and when it was opened under local anesthesia considerable pus escaped. We secured a section of tissue for biopsy examination but later discovered that we had missed the tumor proper.

Four months later she was readmitted for resection of the bowel. She had gotten along well for two months after leaving the hospital but symptoms of an obstruction had developed. A barium enema disclosed that carcinoma was present at the site of the former abscess.

A modified Mikulicz operation was done four months after the first admission, when a large portion of the descending colon and sigmoid and a portion of the abdominal wall were removed.

Her postoperative condition was good. There was considerable slough due to the large dissection but the colostomy functioned well.

The patient died at her home two months after the operation due to acute cellulitis of the neck.

DISCUSSION

Carcinoma of the colon has its own peculiar problems of diagnosis and treatment. Cancer in this location is more amenable to surgery than in any other. Recurrence occurs less frequently. A higher percentage of cures is accomplished. There are certain problems of cancer of the entire colon, and individual problems in the various segments.

In 1936, 15,364 persons died of cancer in the United States. Eleven per cent of this number died of carcinoma of the colon and rectum.[1] Most of these patients are not even seen by a physician until they consult one with either acute obstruction or an abscess. This is true in most cases admitted to the Medical and Surgical Memorial Hospital in San Antonio. Some have discovered a tumor and come in for a diagnosis of it.

In the colon carcinoma occurs in all its various types. Adenocarcinoma is the most common. The cancer begins in the mucosa or in the glands. It tends either to grow into the lumen forming a cauliflower-like mass, or to invade the wall surrounding the gut like a napkin ring. In the first type the tumor may reach a surprisingly large size before producing symptoms. While not an early sign, ulceration occurs more often in the cauliflower type. Blood and pus can then be found in the stools. In the invasive type the lumen of the colon may be narrowed greatly by the encirclement of the cancer

before any signs of obstruction occur. A slight swelling of the mucosa may then complete the obstruction. Under treatment and starvation this swelling may subside and gas and liquid feces may pass so that the obstruction is partially relieved. These obstructions usually occur with dramatic suddenness and demand surgical relief.

Cancer of the colon may occur at any age, though the great majority of patients are between 50 and 70 years of age. It is never safe to rule out cancer on the basis of youth alone. Cancer occurs equally in men and women.

Metastasis is late in cancer of the colon. This usually takes place by means of the lymphatics and in the mesentery. Cancer also spreads by direct extension and occasionally by the blood stream.

Often there has not been any previous operation or history of any severe gastrointestinal symptoms.

Acute obstruction is often the first sign in an elderly individual.

It is true that many of these patients give a history of some symptoms that should have caused them to seek medical aid, such as increasing constipation due to obstruction or discomfort in the abdomen, largely secondary to hyperperistalsis. Jones[2] places great importance on changes of bowel habits or sensation and bleeding. Jelks[3] states that any changes in the gastrointestinal life of an individual over 30 years of age may be an early sign of cancer.

Loss of weight and cachexia are not early symptoms. Anemia is not prominent until later, unless the lesion is in the cecum or ascending colon. If in this location, a very severe anemia may be produced, the hemoglobin usually falling below 50 per cent.

Pain and constipation are usually dependent upon the appearance of obstruction. In cancer of the colon, as elsewhere, pain is not an early sign. When obstruction takes place there is the typical cramp-like colicky pain. This is then followed by distention and vomiting. The distention may become very great.

In abscess formation the pain is localized and may closely simulate that of appendicitis or diverticulitis over the involved area. A tender mass may usually be felt. The tenderness may be very marked. Leukocytosis and fever are present. Obstruction may occur concurrently with the abscess or as the result of it. An inflamed diverticulum may also cause an abscess and may closely resemble a tumor or cancer.

The presence of a mass necessitates an investigation. These tumors may be found in any part of the colon. They often present difficult diagnostic problems. They may be freely movable or fixed. A tumor may be outside the colon yet so encroach upon it as to cause

partial obstruction. On the other hand there may be definite signs of obstruction without any palpable tumor.

In the diagnoses of these conditions, the history is of the greatest importance. Great significance attaches to any change in bowel habits increasing constipation, indigestion and colicky pain or obstruction.[4] The x-ray, the laboratory, the proctoscope and surgical exploration are also needed.

The sedimentation rate is high as in all cancers. Anemia is not so severe in cases of cancer of the left colon as in those of the cecum or ascending colon. The differential blood count may not be of

Fig. 1. Barium enema. Characteristic overhanging margin and obliteration of mucosal pattern seen in cancer of the bowel.

much help. Occult blood in the stool is present in some ulcerative non-malignant conditions in the intestinal tract.

The x-ray examination is most important. A gastrointestinal study may miss a cancer of the colon unless a barium enema is also used. We think a barium enema is a most valuable aid in detecting cancer of the colon, especially above the level reached by the proctoscope. A contrast enema is especially useful in finding polyps. The enema will not only confirm the diagnosis but will also locate the tumor and may to a great extent determine its character. In cancer the outline of the tumor, with the overhanging margins of normal mucous membrane may be seen. The mucosal folds in the lesion are obliterated. Extensive tumors outside the bowel may encroach upon the lumen but they do not blot out the mucosal markings.

The proctoscope is very useful when tumors are in the rectum. A biopsy may be obtained as well as a view of the tumor.

Surgical exploration may still be required to establish the diagnosis in complicated cases.

In the presence of an obstruction nothing more than relieving the occlusion is permissible. The mortality rate in this type of case is high. After the obstruction has been relieved time must be given for the bowel to regain its tone before any further surgery is done. In cases of abscess the problem is gravely complicated. The abscess must be drained, and obstruction, if present, relieved and treated

Fig. 2. Barium enema. Tumor outside of colon. Remnants of the mucosal pattern are still present.

until such a time as it is advisable to complete the operation. If the bowel has been overdistended by an obstruction and has not regained its tone, sutures will slough out or leakage will occur around the sutures.

Carcinoma occurs in the descending colon and sigmoid in about 62 per cent of cases.[5] The two cases reported were of this type. Carcinoma of this part of the colon more often causes obstruction as the feces are not so liquid. The chief difference in this segment is the more solid type of stool and the difficulty of operations. The left ureter and the arteries, mid colic and left colic, supplying the bowel may be endangered in operations in this quarter. Permanent colostomies are more satisfactory on the descending colon than they are on the ascending or transverse colon. The greater mobility of

the left colon permits of greater ease in resections and in reestablishing the continuity of the bowel. When the cancer is near the spleen the splenocolic ligament may have to be divided. If no obstruction has been present a one stage anastomosis may be done. All pressure must be kept off the suture line by a cecostomy or some similar procedure, to divert the fecal current.

Surgery of the colon is much more exacting than other intestinal surgery. Peritonitis is given as the most frequent cause of death following operations on the colon. This is directly traceable to breaks in the technic or a failure in the suture line. The contents of the colon are most infectious. The peritoneum may withstand considerable contamination at one time but it will not stand continuous or repeated doses of infection.

The lymphatics and glands draining the area must be removed with the tumor. The dissection should be done with the idea of getting as much of the cancer-bearing area as possible rather than the re-establishment of the continuity of the intestine. A permanent colostomy is compatible with health and normal activity. Some of these people do not even need to wear a colostomy bag. A half hour or so in the morning is devoted to emptying the bowel and care of the colostomy the rest of the day requires only a simple dressing.

We have always used a Mikulicz operation or some modification of it. A multiple stage operation, in our opinion, greatly lowers the mortality. In more expert hands a one stage operation may be done but even then the time is likely to come when it may leak or fail in some other way. The multiple stage technic has some disadvantages such as a longer hospital stay, fecal drainage of the wound over the abdomen and disagreeable dressings, but there is much less danger. The colon does not take sutures as kindly or heal as rapidly as the small intestine.

The abdomen is usually opened through a left rectus incision and the tumor mass freed. If feasible, the tumor and associated colon are brought out of the abdomen through a separate small incision. If this is not easily done the tumor is brought out through the original incision. A V-shaped section of the mesentery and the glands are removed, the intestine going to and from the tumor sutured together and exteriorized, and the incision closed snugly around this mass.[5] The colon is not sutured to the peritoneum. The mass may be supported on a glass rod or its weight may be sufficient to keep it from retracting into the abdomen. We have found flexible collodion to be efficient in protecting the suture line from infection. The bowel may be clamped off and the tumor cut away or it may be left alone and opened later. The clamps are not removed for twenty-four hours to forty-eight hours. Jones[6] believes that limiting the

oral intake of fluids prevents nausea, vomiting and hiccups. If nothing is placed in the stomach distention will be slow to develop. If obstruction has been present, a catheter or large tube may be placed in the proximal portion of the intestine and the fecal current drained into a bottle beside the bed. The sutures holding the tube in place will, eventually, slough out and the feces will drain over the wound and abdomen.

The closure of the colostomy or cecostomy may present some difficulty. Often this may be overcome by dissecting out a liberal portion of gut to invaginate and close the wound edges over it.

REFERENCES

1. Allen, A. W., and Welch, C. E.: Malignant Disease of Colon; Factors Influencing Operability, Morbidity and Mortality, Am. J. Surg. *46:* 171-180 (Oct.) 1939.
2. Jones, D. F.: Carcinoma of Rectum and Colon, South. M. J. *29:* 339-344 (April) 1936.
3. Jelks, E.: Observations on Early Diagnosis of Gastrointestinal Cancer, South. Surgeon *6:* 299-304 (Aug.) 1937.
4. Renshaw, R. J. F.: Diagnosis of Carcinoma of Colon, S. Clin. North America *19:* 119-1122 (Oct.) 1939.
5. Lahey, F. H.: Mikulicz Resection for Carcinoma of Colon, S. Clin. North America *19:* 637-647 (June) 1939.
6. Jones, T. E.: Postoperative Treatment of Carcinoma of Colon, S. Clin. North America *17:* 1525-1528 (Oct.) 1937.

WOUND HEALING

Wm. C. Tenery, M. D., F. A. C. S.
Waxahachie, Texas

RECENT medical literature has been so largely concerned with the subject of wound healing that any further contribution to that field is better considered preaching than teaching. However, in view of the fact that the success of the operation depends on the tissues themselves, it seems justifiable to devote some space to a brief review of the recently discovered and proven principles of wound healing. The text of the sermon concerns itself principally with the wound made in the surgical approach to disease.

Since an adequate understanding of the factors which influence the progress of wound healing is predicated on a knowledge of the events of this process, it is proper to review recent contributions to the field, to provide background for subsequent remarks.

Following the closure of a surgical wound the presence in the tissues of such irritants as necrotic tissues and foreign substances brings about the *exudative phase* of wound healing. During this phase plasma exudes from the blood vessels in the wound and necrotic tissue is liquefied by enzymes liberated both from dying cells and the neutrophils which are brought into the field with the plasma. Along with these cells the plasma also brings wandering mesenchymal elements such as lymphocytes and monocytes. These join with the fixed mesenchymal elements of the tissues involved to produce the undifferentiated cells which become fibroblasts. In the ensuing *phase of fibroplasia* these cells multiply and, according to Arey,[1] continue to do so without producing collagen fibrils until all the foreign material has been removed and the exudative phase terminated.

The formation of these collagen fibrils constructs adult connective tissue which is typical of the locality in which it is found and restores functional strength to the wound. The return of strength can be measured and forms the basis for any number of experiments relating to the effects of various factors on wound healing. The method commonly employed is that of Harvey and Howes in which they measured the tensile strength of wounds in the stomach walls of dogs by noting the pressure required to rupture these wounds on inflation of the excised stomach. They concluded that, normally, fiber production starts abruptly on the fourth postoperative day and proceeds with decreasing velocity until maximal tensile strength of the wound for this phase is attained around the twelfth to fourteenth day.[2]

Read before the semi-annual meeting of the Texas Surgical Society, Dallas, April 1 and 2, 1940.

Of the factors which may intervene to delay or hinder this normal process none is more serious than the accident of wound infection. In accidental wounds Mason[3] has pointed out the importance of considering the source of the contaminating organism. Bacteria which have recently been in contact with human hosts or other suitable culture medium have a shorter period of incubation in human tissues than those which have been subjected to the rigors of life under adverse circumstances. The ease with which these bacteria gain a foothold in a wound depends in a large measure on their ability to adapt themselves rapidly to life in the tissue fluids and it is chiefly bacteria of human origin which possess this ability.

Ives and Hirshfield[4] have shown that all surgical wounds are contaminated. The majority of postoperative wound infections studied by them were found to be caused by the same bacteria which contaminated the wound at the time of operation. Meleney,[5] as the result of a nine year study, concluded that the possible sources of wound contamination were from the nose and throat of the operating personnel, the skin of the patient, the air of the operating room and the materials and instruments used. I feel that there is considerably more opportunity for contamination from the skin edges than is commonly recognized and, in order to exclude these edges from the field, I clip rubber dam over the tetra towels before proceeding to deeper layers. Since methods for the sterilization of the operating room air are not as yet wholly satisfactory it is good practice to reduce the time of exposure of the wound to the minimum consistent with careful work.

Good hemostasis favors wound healing in that the presence of blood and clots in the wound provides a culture medium for bacteria, prevents direct apposition of tissues and delays the initiation of fiber production which must wait until foreign bodies have been removed.

One of the most important foreign bodies with which the wound must cope is the suture material unavoidably left in its tissues. With regard to the amount of this necessary evil it is obvious that the optimum quantity is the least amount which will do the most good. Whipple has suggested that since, in his experiments, the tissue reaction persists for one day longer in gut sutured wounds than in those containing only silk as suture material, silk should be employed wherever possible. However most surgeons are of the opinion that it is the size of the suture used and the careful handling of tissues which the use of small sizes requires rather than the material they are made of which determines the beneficial results of the silk technic. Howes[6] demonstrated that the immediate strength of the sutured wound depends more on the holding power of the

tissue and the number of sutures used than the actual strength of the suture. Even in size 0 it is sufficient to meet Whipple's demand for a suture twice the tensile strength of the tissues sutured even in the case of fascia, provided that multiple interrupted sutures are used. The functional strength of No. 0 gut was shown by him to exceed the holding power of any tissue. It is my practice to use 0 and 00 where I once used 2 and 1.

Howes also points out the weakness of a union in which the sutures must pull parallel to the tissue fibers. The anatomic incisions advocated by Singleton and Blocker[7] provide fascial divisions which allow suturing at right angles to tissue fibers and thus yield a stronger sutured union.

The employment of deep bite sutures was not found to increase the strength of the wound materially and their use is to be avoided since they tend to impair the circulation in the included tissues, blood and rest being recognized as the fundamental requirements for the healing of any tissue.

Of late the importance of the role vitamins play in wound healing has been stressed and considerable experimental work in this field has yielded much of clinical value. Ishido,[8] in 1923, showed that animals on a vitamin-free diet exhibited delayed wound healing in comparison both with normally nourished animals and those underfed on a normally constituted diet. Ishido's work was carried out on animals without any vitamins at all but subsequent work has revealed the parts played by at least two of these substances.

The action of vitamin A is thought by Wohlbach[9] to be concerned with the repair of epithelial structures. As yet, however, there has been no extensive clinical application of the principle.

Vitamin C has received considerably more attention. Lanman and Ingals[10] showed that normal tensile strength in experimental wounds did not develop in as long as 30 days in animals maintained on a low vitamin C diet. They reported that "scar tissue in these animals was distinctly abnormal, being livid and soft in consistency. Histologic study of the wounds in the partially ascorbutic group showed defective repair of the corium and a poor production of collagen in the scar." Wohlbach's experiments similarly indicated a defect in collagen production and he found evidence of a quantitative relationship between the amounts of vitamin C administered to experimental animals and the amount of collagen formed. He speculates that since mitosis goes on in the absence of vitamin C the role of the vitamin must be a late one and is possibly concerned with the condensation of collagen from the fluid intercellular material.

Lund, in 1939,[11] and Bartlett, Jones and Ryan[12] have demonstrated that following surgery there is a drop in the plasma vitamin C level which cannot be attributed to excessive secretion of the vitamin but must be assumed to be due to its utilization, presumably in the process of wound repair. In addition to its prevalence, as pointed out by Holman,[13] in patients in low economic levels this form of vitamin C deficiency must also be anticipated and treated.

Winfield[14] asserts that all patients with abdominal wound disruptions at the Detroit Receiving Hospital in the last two years have shown a vitamin C deficiency. I feel personally that part of our failures in hernias are due to this cause and that in the absence of adequate laboratory facilities for detection of the deficiency we should saturate our patients with vitamin C before doing hernia repairs.

Aside from the vitamins the diet supplies, other factors exert an influence over wound healing. Clark[15] in 1919 observed that the initiation of granulation in surface wounds of dogs fed on high protein diets occurred much earlier than in dogs fed on normal or low protein diets. He suggested that the early healing was a product of the general acceleration of cellular activity brought about by the proteins' specific dynamic action on body metabolism. Harvey and Howes,[16] measuring the development of tensile strength in stomach wounds in dogs, found that maximal wound strength is attained at least two days earlier in animals on a high protein diet than in those on normal maintenance diets. Since they found no decrease in the lag period preceding the initiation of fibroplasia they concluded that the effect is one of increased fibroplastic activity.

In animals fed low protein diets, wounds seem not only to be without the stimulus of adequate protein but also suffer from the edema caused by hypoproteinemia. Jones[17] in 1936 found that in hypoproteinemic dogs the water content of the gut wall was increased over the normal by as much as 7 per cent. Thompson, Ravdin, Rhoades and Frank,[18] in experimental work on hypoproteinemic dogs, found that 72 per cent of abdominal wounds failed to heal. At biopsy these wounds were pale and edematous and as late as 14 days after operation fluid could be expressed from the wound surfaces. There was no apparent attempt at union, the tissues being held together only by the sutures. Incidentally they observed that only the knots of catgut sutures remained intact whereas silk was found to be still holding. Fibroplasia was greatly retarded and only occasionally appeared in sections of wounds seven days after operation. The histologic picture was one of marked delay in wound repair.

Another application of our present day knowledge of water and electrolyte balance in surgical patients should be the careful avoidance of any degree of dehydration, since McKay[19] has shown that wounds in dehydrated rats heal poorly. He suggests that dehydration results in sufficient destruction of protoplasm to weaken tissues in general whether or not they have undergone trauma incident to surgery.

SUMMARY

In this paper I have attempted to point out some of the factors which influence wound repair. I feel that since it is our duty to make wounds in the approach to disease we should be more critical in our study of this process. More attention to the preoperative study of patients and to the careful handling of tissues at operation will be rewarded by more perfect reconstruction of the tissues disturbed.

REFERENCES

1. Arey, L. B.: Wound Healing, Physiol. Rev. *16:* 327-406 (July) 1936.
2. Howes, E. L., and Harvey, S. C.: The Clinical Significance of Experimental Studies in Wound Healing, Ann. Surg. *102:* 941-946 (Nov.) 1935.
3. Mason, M. L.: Wound Healing, Internat. Abstr. Surg. *69:* 303-315 (Oct.) 1939; in Surg., Gynec. & Obst. (Oct.) 1939.
4. Ives, H. R., Jr., and Hirshfield, J. W.: The Bacterial Flora of Clean Surgical Wounds, Ann. Surg. *107:* 607-616 (April) 1938.
5. Meleney, F. L.: Infection in Clean Operative Wounds, Surg., Gynec. & Obst. *60:* 264-276 (Feb.) 1935.
6. Howes, E. L.: Immediate Strength of Sutured Wound, Surgery *7:* 24-31 (Jan.) 1940.
7. Singleton, A. O., and Blocker, T. G.: The Problem of Disruption of Abdominal Wounds and Postoperative Hernia, J.A.M.A. *112:* 122-127 (Jan. 14) 1939.
8. Ishido, B.: Ueber Beziehungen der Avitaminose zur Wundheilung, Virchows Arch. f. path. Anat. *240:* 241-248, 1923.
9. Wolbach, S. B.: Vitamin C and the Formation of Intercellular Material, New England J. Med. *215:* 1158-1159 (Dec. 17) 1936.
10. Lanman, T. H., and Ingalls, T. H.: Vitamin C Deficiency and Wound Healing, Ann. Surg. *105:* 616-625 (April) 1937.
11. Lund, C. C.: Effect of Surgical Operations on Level of Cevitamic Acid in Blood Plasma, New England J. Med. *221:* 123-127 (July 27) 1939.
12. Bartlett, M. K.; Jones, C. M., and Ryan, A. E.: Vitamin C Studies on Surgical Patients, Ann. Surg. *111:* 1-26 (Jan.) 1940.
13. Holman, Emile: Vitamin and Protein Factors in Pre-Operative and Post-Operative Care of the Surgical Patient, Surg., Gynec. & Obst. *70:* 261-269 (Feb.) 1940.
14. Winfield, J. M.: Personal communication to the author.
15. Clark, A. H.: The Effect of Diet on the Healing of Wounds, Bull. Johns Hopkins Hosp. *30:* 117-120 (May) 1919.
16. Harvey, S. C., and Howes, E. L.: Effect of High Protein Diet on the Velocity of Growth of Fibroblasts in the Healing Wound, Ann. Surg. *91:* 641-650 (May) 1930.
17. Jones, C. M.: Protein Deficiency, New England J. Med. *215:* 1152-1155 (Dec. 17) 1936.
18. Thompson, W. D.; Ravdin, I. S., and Frank, I. L.: Effect of Hypoproteinemia on Wound Disruption, Arch. Surg. *36:* 500-508 (March) 1938.
19. Thompson, W. D.; Ravdin, I. S.; Rhoads, J. E., and Frank, I. L.: Use of Lyophile Plasma in Correction of Hypoproteinemia and Prevention of Wound Disruption, Arch. Surg. *36:* 509-518 (March) 1938.
20. Bird, C. E., and MacKay, E. M.: The Healing of Wounds, Surg., Gynec. & Obst. *54:* 872-881 (June) 1932.

The Southern Surgeon

Published Monthly by
The SOUTHERN SURGEON PUBLISHING COMPANY
701 Hurt Building
ATLANTA

L. MINOR BLACKFORD, M.D.
Editor

B. T. BEASLEY, M.D.
Managing Editor

WALTER G. STUCK, M.D.
Associate Editor

Subscription in the United States, $5.00

VOLUME IX NOVEMBER, 1940 NUMBER 11

EVIPAL AS A BASAL ANESTHETIC

Crawford W. Long introduced sulphuric ether as an anesthetic agent on March 30, 1842. Pain and suffering being thus abolished in surgery, operations became more common and patients more easily consented to undergo surgical treatment. There remained, however, the mental anguish and dread of entering the operating room; the psychic shock of seeing the instruments; the fear of having a mask placed over the face with the consequent strangling or stifling sensation of taking the anesthetic. Refinements have been made during the intervening years which obviate many of the objectionable features. The anesthetic as administered by Long would seem exceedingly crude today.

As new methods or agents have been introduced, controversies have ensued. Each individual naturally espouses those methods most familiar to him. With them he is sure he gets better results than will his equally enthusiastic confrere who employs other means of attaining the same end. Practically all of these improved methods have their virtues and indications, and as yet the universally exclusive anesthetic has not been found. What is good for one type of case or individual may be contraindicated for another.

An excellent criterion in selecting the anesthetic is, "Would you take the anesthetic you advocate for your patient?" At a comparatively recent meeting of the Southern Surgical Association a paper on spinal anesthesia was read, and the discussors waxed so enthusiastic that many of those present were beginning to feel almost criminally negligent in not using it. Finally, Dr. Hubert Royster brought the discussion to an abrupt ending by asking for a show of

hands as to how many of the audience would have spinal anesthesia on himself! This explains why spinal anesthesia is still a controversial subject.

One easily falls into a rut and either fails to read of advances or ignores them. In a recent conversation with the editor of a most distinguished surgical journal,* it was surprising to find he knew nothing of the use of evipal soluble as a basal anesthetic when administered per rectum, as first recommended in 1936 by Gwathmey. If a person who keeps up with medical literature as well as he hasn't heard of it, surely many hundreds of others are in a similar position. It seemed timely, therefore, that this subject be again brought to the attention of the profession.

Numerous agents have been used to numb the senses before entering the operating room—morphine, hyoscine, the various barbiturates, avertin—each of which has its advantages. For safety, effectiveness, and lack of postoperative complications or discomforts, however, we feel rectal evipal is the best.

Beecher, in a recent article on some current problems of anesthesia, finds fault with its use because the rate and degree of absorption cannot be controlled. Granting this may be true, the depth of anesthesia can easily and effectively be controlled with coramine, which is a direct antagonist and which can be administered intravenously in practically unlimited amounts. His objection has not been sustained in our experience.

The only two apparently valid objections we have noted are, first, that the patient is very slow to react after operation, and secondly, that respiration is sometimes alarmingly depressed.

The former is more of an economic problem than anything else, since the delayed reaction seems to lessen postoperative discomforts. There has been much less nausea and vomiting; gas pains and distention are not nearly so common or severe; shock is less often noted. But a special nurse for the first night is required much more frequently.

Most of the grounds for the second objection have been abolished by giving metrazol 3 c.c. intravenously and 3 c.c. intramuscularly before the patient leaves the operating room. With this altered technic, there have been very few cases in which any depression of respiration has been noted and in no case was it alarming. As a further precaution, Gwathmey sometimes orders a retention enema of black coffee.

How much less shock to a delicate and perhaps high-strung nervous mechanism is it for a patient to go peacefully to sleep in his

*It is not necessary to give its name.—*Editor.*

room, and not even to realize when he goes to the operating room, than it was with the comparatively crude anesthetic of Long! And about nine times out of ten, the first words on awakening are to ask when is the operation going to be done. Most assuredly so pleasant and valuable a method has escaped the notice of most of the profession or it would be used more generally.

Age is apparently no barrier to its use. It has been satisfactorily used in an infant of three weeks and with equally as good results in octogenarians.

The simplicity of the technic is one of its greatest advantages. The patient receives 3 grains of seconal or nembutal the night before operation; two hours before operation he is given a cleansing enema of soda bicarbonate; an hour later a hypodermic of ⅓ grain pantopon and 1/150 grain atropine. Twenty minutes after the hypodermic, that is, forty minutes before the time of the operation, the evipal solution is administered. The contents (3 Gm.) of an ampoule are dissolved in 30 c.c. of distilled water—no neutralization nor acidification of the solution or anything else has to be done. The desired dose (0.2 c.c. of this 10 per cent solution per pound of body weight, with a maximum of 30 c.c.) is injected into the rectum through a small catheter, followed by a few cubic centimeters of distilled water. The catheter is clamped and left in place. The patient has a feeling that he can't hold the solution, but he will, and he will be asleep in about five minutes. There may be a temporary drop in blood pressure, or depression of respiration, but each of these can be restored to normal by giving either coramine or metrazol.

Four years' experience has convinced us of the safety, efficacy, desirability, and value of this basal anesthetic which was recommended first by Gwathmey. Without exception the patients have been loud in its praise, and much more comfortable postoperatively.

WILLIAM PERRIN NICOLSON, JR., M. D.

BOOK REVIEWS

The Editors of THE SOUTHERN SURGEON *will at all times welcome new books in the field of surgery and will acknowledge their receipt in these pages. The Editors do not, however, agree to review all books that have been submitted without solicitation.*

ATLAS OF CARDIOROENTGENOLOGY. By HUGO ROESLER, M. D., F. A. C. P., Associate Professor of Roentgenology; Cardiologist in the Department of Medicine, Temple University School of Medicine and Hospital, Philadelphia. 124 pages, with 166 illustrations. Price, $8.50. Springfield and Baltimore: Charles C Thomas, Publisher, 1940.

The scientific exhibits at the annual conventions of the American Medical Association are certainly not the least attractive nor the least informative of the opportunities offered there to increase one's knowledge. One friend of ours makes a point of spending a half a day in a general review of the exhibits and then he devotes most of the rest of the time to an intensive study of those that especially appeal to him. He figures that it is impossible to hear all the papers presented in the many sections, that he would suffer severe mental indigestion if he did and, anyway, he will have the opportunity of reading the papers in the quietude of his own study when they are published, whereas the exhibits can only be fully studied in the convention hall. This reviewer, following his advice, has at two meetings of the American Medical Association spent many hours in the booth of Hugo Roesler. His exhibits included histories of cardiac cases, with electrocardiograms, x-rays of the heart taken during life, often in diagonal views, with the hardened gross specimen in serial section to enable one to determine exactly what the various structures were.

With infinite pains Roesler's exhibit has now been presented in the form of an atlas. The large reproductions of the roentgenograms are superb, the photographs of the hearts are clearly reproduced, and there is sufficient text to make everything clear. To the man who is interested in the gross anatomy and pathology of the heart or in roentgenology this book is beyond price. And one should recall the heart now lies within the surgeon's domain.

The reviewer earnestly hopes that this book will meet with the popular success that it merits, for if it does he can anticipate in a couple of years a second edition with more cases.

L. M. B.

SYNOPSIS OF PRINCIPLES OF SURGERY. By JACOB K. BERMAN, A. B., M. D., F. A. C. S., Assistant Professor of Surgery, Indiana University School of Medicine, Indianapolis. 615 pages, with 274 illustrations. Price, $4. St. Louis: The C. V. Mosby Company, 1940.

The first half of this book deals with the fundamentals on which modern surgery is based, with especial emphasis on the deranged physiology observed with surgical conditions. It is becoming increasingly clear that such knowledge constitutes a most important difference between a real surgeon and a clever butcher boy. Dr. Berman has performed a good work in assembling and digesting so much valuable material, and in presenting it so clearly.

The author emphasizes that, in cases of head injury, during the first few days one should *not* move the patient to secure an x-ray, that one should *not* perform a lumbar puncture at once. He also incorporates the Ochsner treatment (procaine into the sympathetic ganglions) for thrombophlebitis. On the other hand, one is surprised that the author of a textbook does not know that the modern artificial larynx is made without use of electric principles: they were tried and found wanting. When he states that questionnaires were sent in 187 cases of carcinoma of the breast and these were returned in 89 cases,

and then proceeds to draw conclusions from the 89 replies, one is appalled.

While the strictly surgical part of the book is uneven, this synopsis is warmly recommended. It should prove extremely valuable to undergraduates and house officers as an auxiliary text, and it should prove valuable to almost any student of surgery.

A TEXTBOOK OF PHYSIOLOGY. By WILLIAM H. HOWELL, Ph. D., M. D., Sc. D., LL. D., Emeritus Professor of Physiology in the Johns Hopkins University, Baltimore. Fourteenth Edition, Thoroughly Revised. 1117 pages with illustrations. Price, $7.50. Philadelphia and London: W. B. Saunders Company, 1940.

When the name of Howell is mentioned among medical men nearly every one will think of physiology. In fact, Howell's Physiology is so universally used as a text when we think of physiology we think of Howell. The fourteenth edition is the 1940 model of a 1905 classic.

As Dr. Howell points out in the preface—"Research literature in physiology increases from year to year. There is, fortunately, no sign of abatement in its rate of growth. New discoveries, new data on old problems, and new points of view are appearing constantly. They add to and subtract from the corpus of accepted physiological facts, and textbooks in the subject must be revised frequently to keep pace with the changes."

New additions will be found in every section of the book. The section on the circulation of blood and lymph is to my mind among the best in print. There has been much added of course to the section on Secretion of Ductless Glands and a compact, understandable, yet complete dissertation on the various vitamins. The latter, with its unusual lucidity, alone is worth the price of the book.

In short, Howell's Physiology is an up to date, well rounded volume, suited ideally as a text for the student and a reference for the practitioner.

—BERNARD P. WOLFF, M. D.